STATISTICAL ANALYSIS OF BIRD ATLAS DATA

FROM SWAZILAND

BY

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The question of what determines the observed geographical distributions of animal species is one of great interest to natural scientists. In general terms, these distributions are known to be related to a number of environmental factors, but the nature of the relationships and the relative importance of the different factors remain poorly understood. This investigation sets out to obtain more insight into these questions by using statistical methods to explore the relationships between the observed geographical distributions of bird species in Swaziland and a number of environmental variables.

In 1985 I set out to compile a bird atlas of Swaziland. Data were accumulated between 1985 and 1991 and the bird atlas submitted to a publisher in May 1993. The text of the bird atlas is included here as Appendix 2 because it provides the essential background to this dissertation. The introductory section of the atlas includes a description of the data gathering process. The analysis included in the bird atlas was aimed at a popular readership and was not intended to form part of an academic dissertation.

Chapter 1 describes the use of logistic regression to investigate the relationships between the bird distribution patterns and a set of environmental variables and to predict the distributions.

Chapter 2 describes the results of applying the methods described in Chapter 1 for all of the bird species for which data were available. Because this paper was aimed at a different readership, some repetition of material contained in Chapter 1 was unavoidable.

In Chapter 3, biplot techniques were used to obtain a graphical representation of the bird atlas data. Cluster analysis techniques were used to obtain a partition of Swaziland into avifaunal regions, and the biplot was used to verify the solutions obtained by cluster analysis.

CHAPTER 1

THE USE OF LOGISTIC REGRESSION ON SWAZILAND BIRD ATLAS DATA

SUMMARY

1. The method of logistic regression was used to model the observed geographical distribution patterns of bird species in Swaziland in relation to a set of environmental variables.
2. Reporting rates derived from bird atlas data are used as an index of population densities. This is justified in part by the success of the modelling process.
3. For each species the variables which were significantly related to its distribution were identified.
4. Various methods for coding environmental variables from maps were investigated.
5. A jack-knifing technique was used to demonstrate the predictive power of the models.
6. A criterion for assessing the goodness of fit of the logistic models was derived.

Key-words: bird atlas, environmental variables, logistic regression, relative population densities, reporting rates, Swaziland.

INTRODUCTION

Logistic regression was previously used to predict bird distributions in Lesotho based on a binary response variable representing the presence or absence of a species in a geographical grid unit by Osborne & Tigar (1992). They reduced their set of explanatory variables describing habitat and land use to four principal components, so that it was not possible to relate bird distributions to the explanatory variables that were observed. This analysis extends their work in three ways: Firstly, it uses full binomial (rather than binary presence/absence) modelling, thus taking into account the relative abundance of species. Secondly, it relates the distributions of the bird species to the individual environmental explanatory variables. Thirdly, the availability of comprehensive data on the distribution of birds in the study area (Appendix 2) is made use of to assess the fit of the

models critically and to derive a criterion for measuring goodness of fit.

Logistic regression was also used to model the distribution of three kangaroo species in Australia in relation to a set of climatic variables (Walker 1990). Here again, binary (presence/absence) modelling was used rather than binomial modelling. Cruder methods were used to model the distribution of Elapid snakes in Australia in relation to climatic variables (Nix 1986) and to relate the distributional boundaries of wintering birds in North America to environmental variables (Root 1988). In the latter study, estimates of relative densities were available, but were converted to presence/absence data for the analysis.

STUDY AREA AND METHODS

Data collection - bird distributions.

The Kingdom of Swaziland covers an area of about 15 000 sq km. and has a diverse natural environment. The altitude ranges from 200 to 1 800 m, the average rainfall varies from 500 to 1300mm per annum and eleven distinct vegetation zones are recognized (Goudie & Price-Williams 1979).

Data on the distribution of bird species in Swaziland were accumulated for the Swaziland Bird Atlas (Appendix 2) in the form of more than 2600 field cards listing the species observed within a 1/8 degree grid "square" (1/8 degree latitude by 1/8 degree longitude) within a calender month. The data were summarised in the form of reporting rates for each species for each grid square. The reporting rate is the proportion of field cards for a grid unit on which the species was recorded and is regarded as an estimate of the relative abundance of the species between grid units (a species is believed to be most numerous where it was recorded most often) (Underhill et al. 1992). The fact that coverage of Swaziland was both comprehensive and far more even than that for other atlas schemes in the region removes some of the possible problems related to considering the reporting rates as an index of relative densities (Underhill et al. 1992). A remaining problem was that of observer bias. Inconspicuous and more difficult to identify species are recorded less often by inexperienced observers (Underhill et al. 1992). This problem was eliminated by using a subset

of the field cards consisting of approximately 1700 field cards compiled by the author. This subset consisted of at least 12 cards per grid square (except for one grid square with six cards) with at least 35 species recorded per card.

Environmental variables.

Data on the environmental variables were obtained from a series of 1 in 250 000 maps (Government of Swaziland 1980) and from the Atlas of Swaziland (Goudie & Price-Williams 1979) (Table 1). Rainfall data were obtained in the form of the estimated mean annual rainfall for each one minute of latitude by one minute of longitude from the Computing Centre for Water Research, University of Natal, Pietermaritzburg.

Three alternative ways for coding altitude were used. It was coded as a continuous variable, as a factor with eight levels, or as a set of eight separate binary variables corresponding to the levels of the factor. The latter method was introduced because it allowed some of the variables to be omitted from the model when their coefficients were found to be not significant, thus yielding a more parsimonious model.

The number of field cards was included as an explanatory variable because for the few squares where the number of field cards was considerably greater than the minimum, the additional field cards related to specific localities within those squares, so that reporting rates were biased in favour of species occurring at those localities.

Three alternative methods of representing the vegetation types as explanatory variables were assessed. The vegetation types occurring within each grid square were represented by a set of 11 continuous variables corresponding to the 11 'veld types' of the natural vegetation map used (Goudie & Price-Williams 1979). For each grid square, the proportion of its area falling within each veld type was recorded. With this method not all of the variables representing vegetation types can be entered simultaneously in a regression model because the matrix representing the values would be singular. A subset of these variables was selected for each species. The second method was to code the vegetation types as 11 levels of a single factor. To achieve this, each

grid square was assigned to the single vegetation type category which covered the largest area within the square. The third method was to represent each vegetation type as a binary variable reflecting either presence or absence in each square.

Trials were made to compare Acock's (1975) veld type classification with that of Goudie & Price-Williams (1979). The latter classification is less widely known than the former, but is based on more extensive fieldwork in the region (l'ons 1967) and was considered to be possibly a more accurate representation of the vegetation of the country. Logistic regression on vegetation types for 9 species of the cisticola family using each veld type classification was carried out and the results compared. The cisticola family was chosen for this comparison because the distribution patterns are reasonably representative of the range of patterns exhibited by all the species.

The geological data were coded in a manner similar to that adopted for vegetation types. A set of six variables with values representing the proportion of the square assigned to the respective geological class in the map by Goudie & Price-Williams (1979) was used. An alternative set of 18 variables representing the geological classes in the more detailed Government of Swaziland (1982) map was also used and results of using the two different classifications were compared for 9 species of the Cisticola family.

Statistical methods

The Genstat statistical package was used to carry out the regression analysis (Payne et al. 1987). A set of environmental variables (Table 1) were entered as possible explanatory variables in the logistic model, with reporting rates of the bird species, expressed as a binomial random variable, as the response variable. Although Osborne & Tigar (1992) used arcsine and square root transformations to improve the normality of some of the explanatory variables, no transformations were used in this study because the method of logistic regression does not require that the explanatory variables be normally distributed (McCullagh & Nelder 1989). For each species, the significant explanatory variables were identified by first running the regression program with each variable alone. In the light of experience with fitting and cross validating the models, criteria were established whereby variables were classified as significantly or not significantly associated with the response variable at the univariate stage.

For each species, a decision was made as to whether to use the continuous variable, the factored variable or the separate variables to represent altitude. It was felt that this decision should not be based solely on the change of deviance associated with each option because the latter two options involved models with a greater number of variables and should not neccessarily be regarded as fitting better when they were associated with a greater change in deviance. The following procedure was therefore adopted. Models were fitted using the first two options, and the resulting changes in deviance compared. This comparison was made between models including all the significant variables. (Comparisons made between the univariate models yielded inconsistent results because sometimes the difference in deviance between the continuous model and the factor was accounted for by other variables in the full model). The continuous variable was selected whenever it was associated with a larger change in deviance. However, when the factored variable was associated with a greater change in deviance than the continuous variable, the cross validation step was used to compare the fit of the models with respect to the sum of prediction residuals using each of the three coding methods and the one resulting in a better fit selected. In these cases, the results were tabulated against the values for the difference in change of deviance in order to establish how great the difference should be in order to offset the disadvantage of the greater number of variables in the models.

In cases where the response variable had zero values for more than one level of the factor (zero cells), the fitting process was unstable as indicated by very large standard errors associated with the coefficients. In some of these cases, the factor variable was associated with a significantly larger change in deviance than the continuous variable and then attempts were made to adjust the limits of the levels of the factor to eliminate the zero cells.

A systematic forward selection procedure was used to fit a 'combined' model, including a subset of all the available variables. A vegetation-type model was also fitted, which included only those variables representing vegetation types in which the species was known to occur. When including vegetation type variables in the 'combined' model, variables with similar coefficients in the vegetation-type model were combined as a single variable after checking that the vegetation type model with the composite variables did not have a significantly smaller change in deviance. In addition, a model containing only abiotic variables (i.e. excluding vegetation types) was fitted and compared to the vegetation types only model.

The standardised residual of a grid square in the 'combined' model was considered high if it exceeded 2.5. The number of bird species for which each grid square had a high residual was counted.

In the initial model-fitting process, a dispersion parameter of 1 was assumed in all cases, as for the binomial distribution (Collett 1991). In order to check whether overdispersion (variability greater than that anticipated) could affect the models, for the two species with the highest mean deviance of the residual, the actual dispersion parameter was estimated (Pearson's chi-squared/degrees of freedom) and the models refitted using the estimated dispersion parameter.

Cross Validation

A jack-knifing technique was applied to test the predictive power of the models (Quenouille 1949; Miller 1974). For each species, the reporting rate data for each of the squares in turn were omitted and the regression coefficients calculated for the restricted model. The new coefficients were then used to calculate a predicted value for the reporting rate for the omitted square and this could then be compared to the observed value. The deviance residuals between the observed and predicted reporting rates for each square were calculated (Hosmer & Lemeshow 1989) and used to identify possible outliers. The sum over the 98 squares of deviance residuals (prediction residuals) was used to assess the goodness of fit of the predicted distributions.

The predicted values of the response variable were represented on a map using the display method of the Swaziland Bird Atlas (Appendix 2) and compared to the corresponding representation of the observed values. On the maps, a circle appears in each square in which the species occurs (or is predicted to occur) with radius proportional to the reporting rate. This display method was also used by Hockey et al. (1989). No circle appears when the predicted number of sightings is less than one, although the corresponding predicted reporting rate is not zero.

For each bird species, the distribution maps representing the predicted and observed distributions were inspected and the comparison related to the sum of prediction residuals, in order to establish a criterion for assessing the goodness of fit of the models in relation to the prediction residuals.

RESULTS

Comparison of Coding Methods for Explanatory Variables

In selecting a coding method for altitude it was found that the model using the continuous variable always produced a better fit than that using the factored variable in terms of the sum of prediction residuals in the cross validation whenever the difference in change in deviance was less than 27 and sometimes produced a better fit when the difference was less than 55. Only when the difference in change of deviance was greater than 55 in favour of the factored variable did the latter invariably produce a better fit (Table 2).

In all cases where the factored variable was preferred to the continuous, the method of using separate variables yielded a slightly better fit, but the improvement was insignificant (less than 1%) and the factored variable was used for convenience. However, in a total of three cases, both the continuous and factored variables were found to be not significantly associated with the response, but a subset of the separate variables was significant and its inclusion improved the fit of the model. In all cases where the factored variable was unsuitable because it contained zero cells, the variable obtained by readjusting the levels was not preferable to the continuous variable.

For vegetation-type coding methods, the continuous method performed better than the binary method in all cases and better than the factor method in all but two cases (Table 3) and in these cases the differences were insignificantly small. When using the factor method, the factor representing the vegetation types often contained several zero cells, with the result that the fitting process was unstable and the associated standard errors were large. The continuous method was adopted as the most suitable way of coding the vegetation type data and was used exclusively in the subsequent model-fitting processes.

In the comparison of veld-type classifications, the regression analysis invariably produced greater changes in deviance using the Goudie & Price-Williams (1979) classification compared to Acock's (1975) classification and the differences were significant (with one exception) after taking into account the greater number of categories (11 versus 8) (Table 4). It is therefore likely that the

former classification describes the vegetation of Swaziland more accurately.

In the comparison of geological classifications, using the classification based on the map by Goudie & Price-Williams (1979), the variables representing geological classes in which the species predominantly occurs were found to be significant for all but one of the species. By contrast, when using the alternative more detailed classification (Government of Swaziland 1982), none of the individual variables were found to be significant in the logistic models. The simpler classification was therefore adopted for use in the modelling process.

Criteria for Significance of Variables

Variables whose inclusion in the combined model was found to improve the fit of the model as measured by the sum of prediction residuals in the cross validation step, were found to be almost invariably among those which had Wald statistic (t) values in excess of two and were associated with changes in deviances of at least five in the univariate models (McCullagh & Nelder 1989). These were then adopted as criteria for identifying which variables were significantly associated with the response variable.

Overdispersion

The over- or under-dispersion of the models, as measured by the mean deviance of the residual, was found to be closely related to the number of observations of the species concerned. The mean deviance was large for species recorded most often and was considerably less than one for the least frequently observed species (Table 5).

For the two species for which the model was refitted using the estimated dispersion parameter, namely (nomenclature follows Clancey 1980) redfaced cisticola *Cisticola erythrops* and croaking cisticola *Cisticola natalensis*, it was found that although the values of the Wald statistic for each variable were smaller, nevertheless all of the variables selected in the initial model fitting process remained significant. The overdispersion, therefore, did not appear to make any real difference to the model fitting process.

Each of the environmental variables entered were significant for at least some of the species and vegetation type was significant for all but four of the 335 species (Table 6). Variables were denoted as highly significantly associated when the variable was associated with a change in deviance which was more than half the change for the combined model. The combined models were found to account for an average of 62.6 % of the total deviance for passerine and near-passerines (sensu Maclean 1985 p xxiv) and 58.7 % for non-passerines (Table 7).

Models consisting of abiotic (climatic, topographic and geologic) variables only were better (in terms of change of deviance) than the vegetation type models in 321 cases out of 335. This indicates that the relative densities of the bird species vary within vegetation types and that these differences are at least partially accounted for by the abiotic variables.

Each grid square had a high residual for a minimum of four and a maximum of 39 out of 335 of the models (Fig 1). It is apparent that high residuals occurred least often in the lowveld, which is the most homogenous of the topographic regions (Goudie & Price-Williams 1979). The modelling process assumes that the explanatory variables are constant within a grid square and therefore the models are expected to fit less well where these variables vary most rapidly.

Cross Validation

For the lazy cisticola *Cisticola aberrans*, one point was found to contribute 84 to the total deviance of 449, with no other point contributing more than 30. This point was then deleted and the analysis repeated. The exclusion of the point was found to make a negligible difference to the fit of the remaining points. For the other species, no single point was found to contribute much more than the others to the total deviance.

The prediction residuals calculated by jack-knifing for some species are included in Table 5. Comparison of the prediction residuals to percentage points of the Chi-square distribution (Hosmer & Lemeshow 1989) was found to be inappropriate as a criterion for goodness of fit because the prediction residuals cannot be less than the residual deviance of the full model. When the total deviance of the model was large, these values frequently exceeded the relevant Chi-squared value

even though the models accounted for high proportions of the total deviance. In many cases, visual examination of the predicted and observed distributions suggested that the fit of the models was in fact excellent. On the other hand, when the total deviance was very small, the prediction residual was found to be considerably less than the Chi-square value even when the fit of the predictions did not look particularly good.

Comparison of the ratio of the total deviance of the full model to the prediction residuals with the observed similarity of the predicted and observed distribution maps yielded a more appropriate measure of goodness of fit. It was observed that the fit always appeared to be good whenever this ratio exceeded one.

A value of one for this ratio implies that the model fits no better than a model representing a constant reporting rate throughout. However, when the predicted distribution maps for species where the ratio was close to one were examined, it was observed that where there was a large difference between the predicted and observed reporting rates, the square was often contiguous with squares whose observed values matched the predicted value (Fig 2d). The actual fit of the model in these cases was therefore generally better than the ratio would suggest.

This ratio had a value greater than one for 324 out of 335 species and a mean value of 2.2 for passerines and near passerines ($n=242$) and 1.9 for non passerines ($n=93$). Eight of the 11 species for which the ratio was less than one were water birds.

An additional measure of the goodness of fit of the models is the ratio of the sum of prediction deviance residuals to the residual deviance of the full model. This ratio indicates how much the predicted values differ from the fitted values of the full model without reference to the observed values (Table 5).

The maps representing predicted and observed distributions for four species (Fig 2) illustrate the fact that the models have predicted both the limits of the distributions of the species as well as their reporting rates within these limits with reasonable accuracy.

DISCUSSION

This investigation has shown that logistic regression can be used to identify the environmental variables which are significantly associated with the geographical distributions of bird species. This is a stronger result than that of Osborne & Tigar (1992), who showed that species distributions could be related to latent variables derived from the environmental variables using principal components.

Comparison of the predicted distribution maps to the observed distributions has established that if bird distribution information was available for some centres and lacking in the intervening areas for some region, then the distributions in the intervening areas could be reasonably accurately predicted.

The success of the modelling process is a justification of the use of reporting rates as an index of population density because it is difficult to conceive of an alternative explanation for the association between reporting rates and the environmental variables.

The model selection process used is in contrast to the method of Osborne & Tigar (1992), who reduced all the available variables to the first four principal components. The first four principal components of the variables do not necessarily coincide with the components which are most significantly related to the response variable, as demonstrated e.g. by Cuadras (1993). Moreover, during the model selection process, the inclusion or exclusion of a single variable was often observed to make a large difference to the fit of the model, as reflected in the value of the prediction residual. Noting also that the models for very few of the species were identical in respect of the variables included, the principal components method was considered to be inadequate.

The method used by Osborne & Tigar (1992) of identifying as outliers individual points with high residuals was found to be potentially flawed. In this study, it was often found that when the fit of a model was poor, there were one or two points which appeared to be outliers on the basis of

their excessive residuals. However, in most of these cases it was possible to obtain a better fitting model by using a different combination of variables, and in the new model the points in question no longer had excessive residuals. (When the model did not fit, the model was wrong, not the data.)

More work needs to be done on the distribution of the sum of prediction residuals before a criterion for goodness of fit can be proposed for general use in logistic regression. However, for the purposes of this study, the criterion derived here was found to be consistent with the observed goodness of fit and was useful in ranking the models and identifying those for which the fit was relatively poor.

Underdispersion of the models for which the number of observations is small was expected because in these cases most of the values for reporting rates for the grid squares are zero and consequently the variability is less than that expected for a binomially distributed variable. On the other hand, overdispersion for models where the number of observations is large is probably attributable at least in part to the fact that the distributions are partly determined by variables other than those which were available for inclusion in the models.

The fact that most of the species for which the fit was relatively poor were waterbirds indicates that the models for these species would probably be improved by the inclusion of further variables representing the occurrence, nature and extent of wetlands. The variables used also probably do not account adequately for the effects of human activities on the environment. It is possible that the species most affected by human activities will be among those for which the fit is relatively poor.

One of the aims of this study was to explore methods for coding environmental variables from maps, and to determine which method is the most suitable at least for Swaziland. Further studies in other regions and at different scales may help to establish whether these methods are generally applicable.

Temperature could not be included as an explanatory variable because no data were available at

the appropriate scale. As temperature is highly correlated with altitude (Goudie & Price-Williams 1979), the inclusion of temperature might not make a significant difference to the models. Moreover, the variables latitude and longitude are expected to act as surrogates (together with altitude) for temperature. Temperature decreases with latitude (though this effect is small over the 1.5 degrees of latitude) and increases with longitude due to the influence of the Indian Ocean which lies less than 50 km away to the east.

The appropriateness of logistic regression in this context is dependent on the assumption of independence of observations of birds in different grid squares. This assumption would be violated if the same individual were observed in different grid squares. It is believed that the assumption is reasonable for most small passerines. The assumption might not be valid for some larger species, especially those of the family Accipitridae. Use of the regression models also assumes that a species occurs wherever environmental conditions are favourable irrespective of its occurrence or non occurrence in neighbouring squares.

TABLE 1

CODING OF THE ENVIRONMENTAL VARIABLES

VARIABLE	EXPLANATION
ALTITUDE	The median of the altitudes read at the north eastern corner of each of 40 random 1x1 km quadrats.
ALTITUDE RANGE (ABS)	The absolute range of the altitudes read at the north eastern corner of each of the 40 random quadrats.
ALTITUDE RANGE (IQ)	The interquartile range of the altitudes read at the north eastern corner of each quadrat.
RAIN	The mean of the estimated mean annual rainfall values for each minute of latitude by longitude.
STREAMS	The number of random quadrats which contain at least 0.5 km of stream.
CARDS	The number of field cards accumulated for the square.
GEOLOGY	The value for each of the six variables is the proportion of the square which is assigned to the corresponding geological type in the map by Goudie & Price-Williams (1979).
RIVERS	The number of random quadrats which intersect a river at least 5 m in width.
PLANTATIONS	The proportion of the square which is covered by exotic timber plantations.
AGRICULTURE	The proportion of the square which is utilized for intensive cultivation of sugar, cotton or citrus.
LATITUDE	The latitude in minutes of the southern boundary of the square.
LONGITUDE	The longitude in minutes of the western boundary of the square.
VEGETATION TYPE	The value for each of the 11 variables is the proportion of the square which is assigned to the corresponding vegetation type in the map by Goudie & Price-Williams (1979).
DAMS	A binary variable representing the presence or absence of artificial impoundments.
FORESTS	A binary variable representing the presence or absence of natural forests.
NATURE RESERVES	The proportion of the square which falls within a nature reserve.

TABLE 2

COMPARISON OF GOODNESS OF FIT OF THE MODELS USING CONTINUOUS AND FACTORED VARIABLES FOR ALTITUDE.

THE NUMBER OF TIMES EACH CODING METHOD RESULTED IN A BETTER FIT (AS DETERMINED BY SUM OF PREDICTION RESIDUALS) FOR EACH RANGE OF VALUES FOR THE DIFFERENCE IN DEVIANCE.

CODING METHOD	DIFFERENCE IN DEVIANCE (FACTORED - CONTINUOUS)		
	<27	27-55	>55
CONTINUOUS	257	8	0
FACTORED	0	15	32

TABLE 3

COMPARISON OF CODING METHODS OF VEGETATION TYPES WITH RESPECT TO CHANGE IN DEVIANCE OF THE LOGISTIC MODEL.

THE TABLE GIVES VALUES OF THE CHANGE IN DEVIANCE ASSOCIATED WITH THE VEGETATION TYPES CODED AS LEVELS OF A SINGLE FACTOR (FACTOR), AS 11 BINARY VARIABLES (BINARY) AND AS 11 VARIABLES WITH VALUES IN THE RANGE (0-10) (CONTINUOUS).

The full data set was used in these comparisons, which accounts for discrepancies in the values of the change in deviance between this table and table 3, where a restricted data set consisting only of field cards compiled by the author was used.

SPECIES	FACTOR	BINARY	CONTINUOUS
WAILING CISTICOLA	420	399	415
RATTLING CISTICOLA	1158	1198	1226
REDFACED CISTICOLA	327	291	374
LEVAILLANT'S CISTICOLA	924	1015	1035
CROAKING CISTICOLA	240	243	266
LAZY CISTICOLA	760	680	747
NEDDICKY	600	537	676
WATER DIKKOP	100	48	118
PURPLECRESTED LOERIE	571	556	689

TABLE 4

COMPARISON OF VELD TYPE CLASSIFICATIONS (ACOCK'S vs GOUDIE&PRICE-WILLIAMS) WITH RESPECT TO THE CHANGE IN DEVIANCE OF THE LOGISTIC MODEL:

SPECIES	ACOCK'S	G&P-W	DIFFERENCE
DESERT CISTICOLA	40	66	26
AYRE'S CISTICOLA	318	360	42
WAILING CISTICOLA	456	463	7
RATTLING CISTICOLA	1068	1166	102
REDFACED CISTICOLA	363	378	15
LEVAILLANT'S CISTICOLA	688	945	257
CROAKING CISTICOLA	189	219	30
LAZY CISTICOLA	687	723	36
NEDDICKY	490	580	90

TABLE 5

GOODNESS OF FIT STATISTICS (CISTICOLA FAMILY & SELECTED SPECIES)

OBS = NUMBER OF OBSERVATIONS OF THE SPECIES
TOT DEV = TOTAL DEVIANCE
COMBINED(%) = PERCENTAGE OF TOTAL DEVIANCE ACCOUNTED FOR BY THE COMBINED MODE
ABIOTIC (%) = PERCENTAGE OF TOTAL DEVIANCE ACCOUNTED FOR BY THE ABIOTIC MODE
VEG (%) = PERCENTAGE OF TOTAL DEVIANCE ACCOUNTED FOR BY THE VEGETATION TYPES MODEL
MDR = MEAN DEVIANCE OF THE RESIDUAL (BEST MODEL)
GF1 = (TOTAL DEVIANCE)/(SUM OF PREDICTION RESIDUALS)
GF2 = (SUM OF PREDICTION RESIDUALS)/(SUM OF RESIDUALS OF THE FULL MOD
* INDICATES WHICH MODEL YIELDED THE BEST FIT FOR EACH SPECIES

	OBS	TOT DEV	COMB %	ABIOTIC %	VEG %	PRED RESID	MDR	GF1	GF2
FANTAILED CISTICOLA	452	237	48	48*	35	168	1.3	1.4	1.4
DESERT CISTICOLA	20	120	63*	56	55	64	0.5	1.9	1.5
AYRES CISTICOLA	240	571	78	75*	71	294	1.4	2.3	1.8
WAILING CISTICOLA	209	663	85	83*	70	152	1.1	4.8	1.4
RATTLING CISTICOLA	954	1458	87	87*	80	238	2.0	6.1	1.3
REDFACED CISTICOLA	571	953	55	48*	39	639	5.5	1.5	1.3
LEVAILLANTS CISTICOLA	408	1219	86	83*	77	302	1.9	4.0	1.5
CROAKING CISTICOLA	532	625	45	41*	35	516	3.9	1.4	1.3
LAZY CISTICOLA	679	1121	74*	72	64	494	3.6	2.5	1.6
NEDDICKY	674	980	72*	69	59	331	3.1	3.0	1.2
CAPE TURTLE DOVE	1327	546	78	78*	47	190	1.4	2.9	1.6
YELLOW FRONTED TINKERBARBET	74	378	90	90*	47	197	0.4	1.9	5.6
FOREST WEAVER	66	404	98*	98	79	20	0.1	20.2	2.5

TABLE 6

NUMBERS OF SPECIES DISTRIBUTIONS WITH WHICH EACH VARIABLE IS SIGNIFICANTLY ASSOCIATED

KEY
T: No. of species significantly associated
p: No. of species significantly positively associated
n: No. of species significantly negatively associated
P: No. of species highly significantly positively associated
N: No. of species highly significantly negatively associated

VARIABLE	T	p	n	P	N
Vegetation type	331	331	0	272	0
Geology	324	324	0	96	0
Altitude	315	108	207	58	97
Rainfall	295	94	201	17	48
Dams	225	147	78	14	0
Rivers	164	108	56	1	0
Cards	214	76	138	1	7
Plantations	250	84	166	1	19
Streams	281	102	179	5	11
Latitude	194	109	85	4	4
Longitude	292	190	102	52	28
Agriculture	228	168	60	5	0
Forests	250	86	166	7	2
Nature reserves	249	83	66	2	0
Altitude Range	206	118	88	4	0

TABLE 7

GOODNESS OF FIT DATA.

SUMMARY STATISTICS: PERCENTAGE OF VARIATION ACCOUNTED FOR BY:	NON PASSERINES MEAN	SD*	RANGE	PASSERINES AND NEAR PASSERINES MEAN	SD	RANGE
COMBINED MODEL :	58.7	19.6	5-92	62.6	17.5	12-98
ABIOTIC MODEL :	55.6	19.2	5-91	60.0	18.1	12-98
VEGETATION :	33.5	14.7	0-66	47.0	17.2	0-85
GOODNESS OF FIT STATISTICS						
GF1 : (TOTAL DEVIANCE/SUM OF PREDICTION RESIDUALS)	1.85	0.86	0.42-6.26	2.23	1.57	0.82-20.20
GF2 : (SUM OF PREDICTION RESIDUALS/SUM OF RESIDUALS FOR THE FULL MODEL)	1.73	1.31	1.03-12.46	1.68	1.82	1.02-26.14

* SD=STANDARD DEVIATION

FIG 1

DISTRIBUTION OF HIGH RESIDUALS

THE SIZE OF THE CIRCLES IS PROPORTIONAL TO THE NUMBER OF SPECIES MODELS FOR WHICH THE GRID SQUARE HAD A HIGH RESIDUAL.
MINIMUM= 4/335 MAXIMUM=39/335.

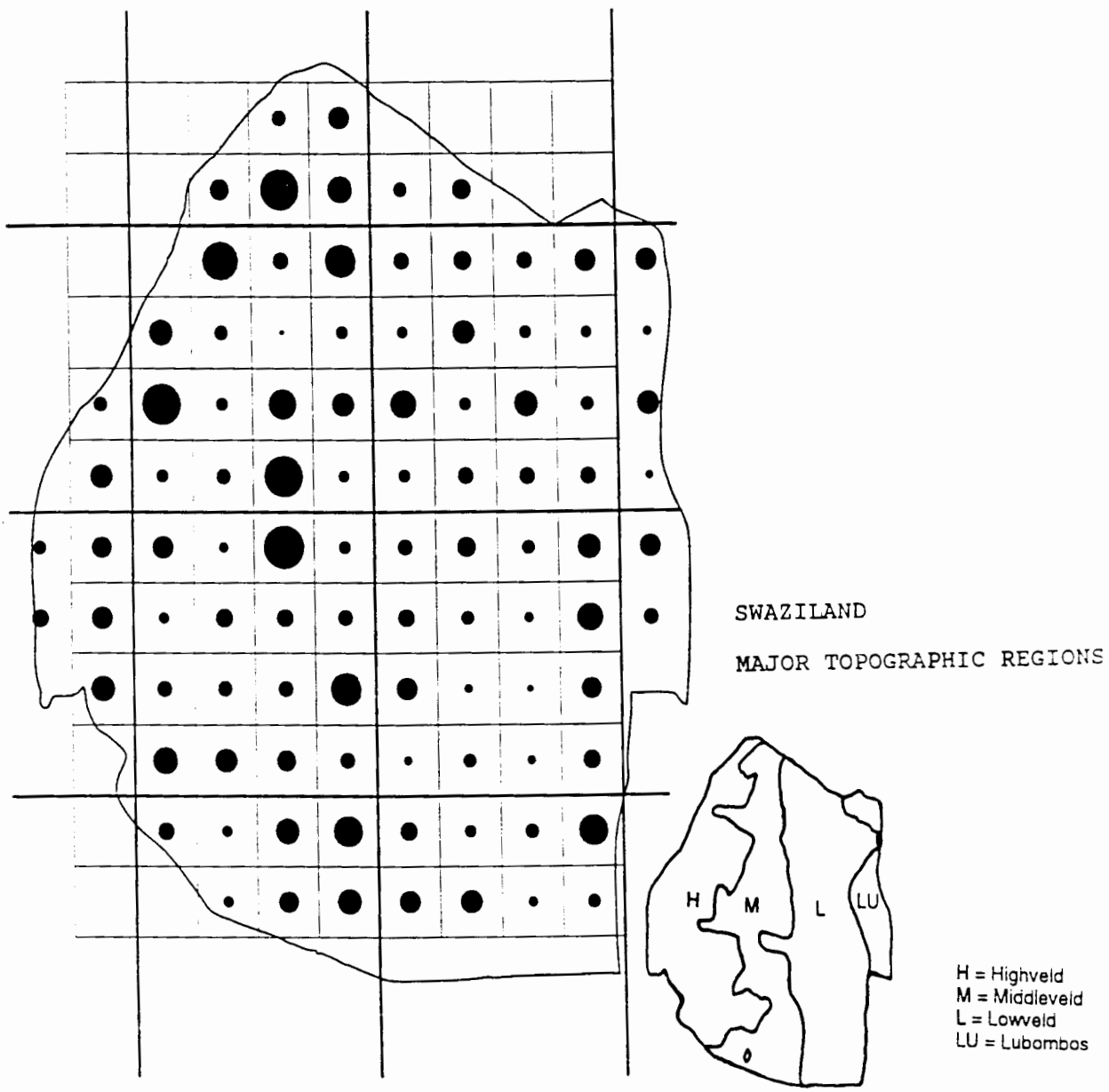
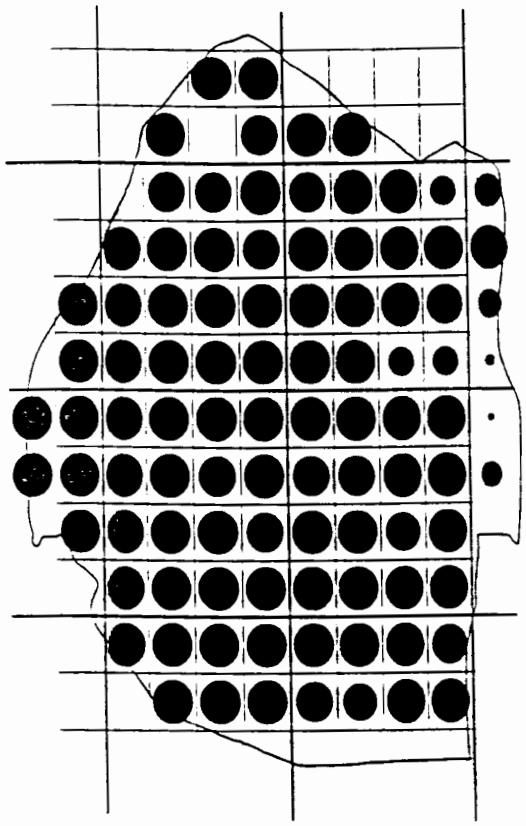


FIG 2. OBSERVED AND PREDICTED DISTRIBUTIONS

2a. CAPE TURTLE DOVE (Goodness of fit stat.: gf1=2.9)

OBSERVED DISTRIBUTION



PREDICTED DISTRIBUTION

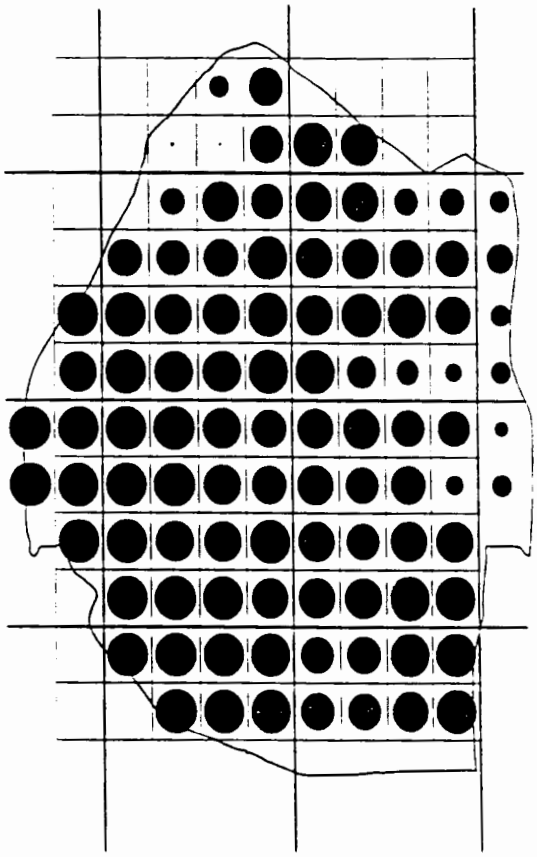
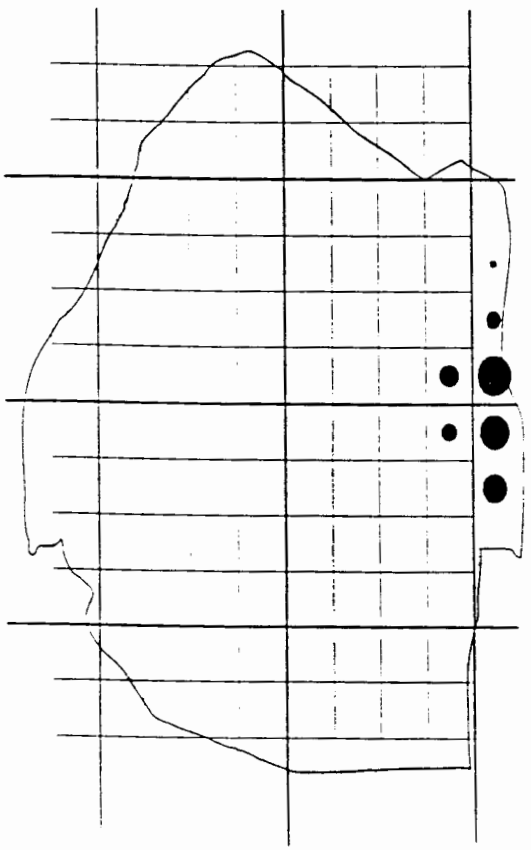


FIG 2b. FOREST WEAVER (Goodness of fit stat.: gf1=20.2)

OBSERVED DISTRIBUTION



PREDICTED DISTRIBUTION

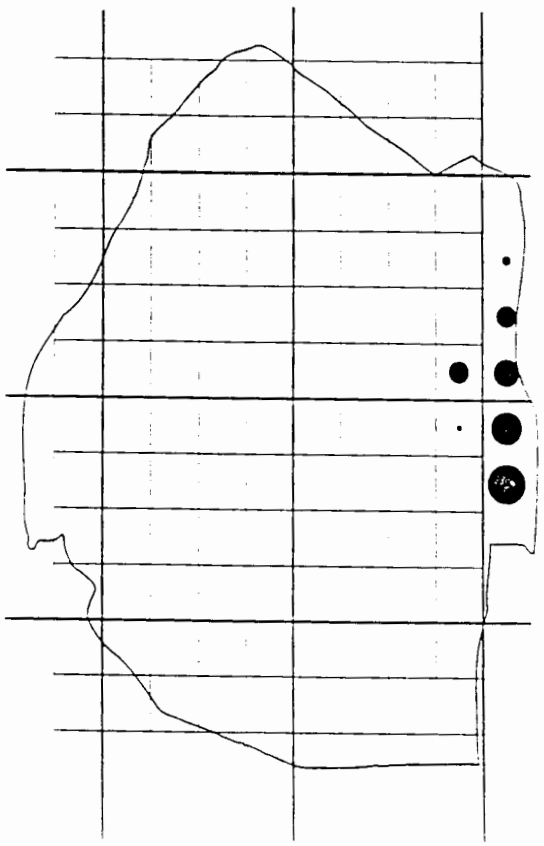
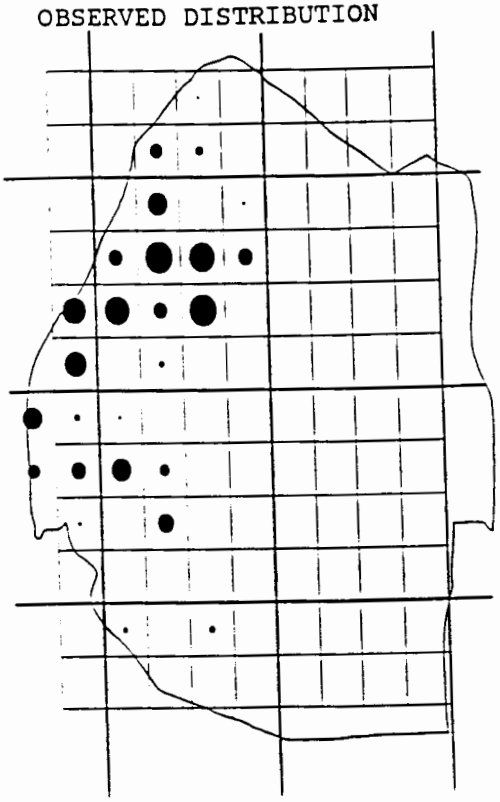


FIG 2c. WAILING CISTICOLA (Goodness of fit stat: gf1=4.8)

OBSERVED DISTRIBUTION



PREDICTED DISTRIBUTION

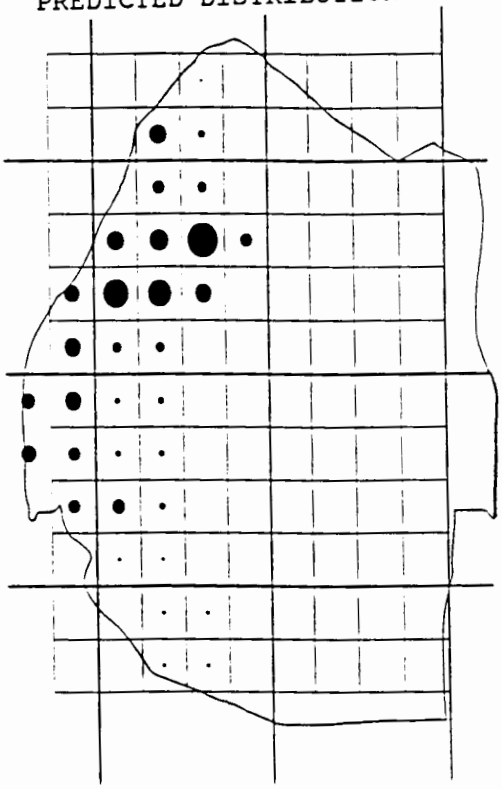
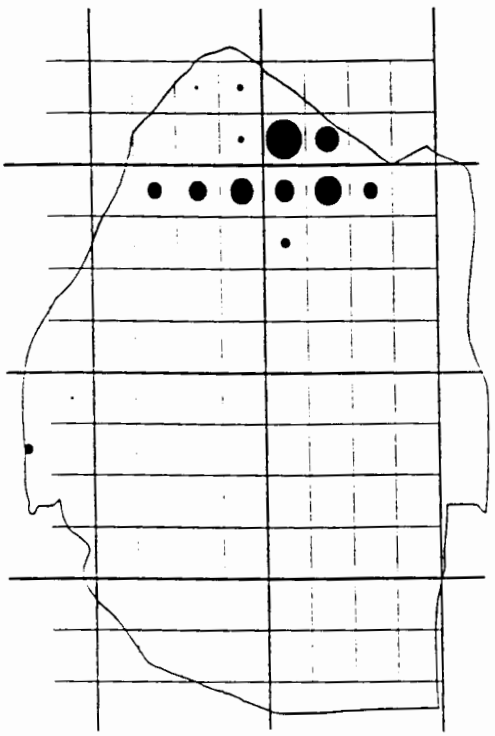
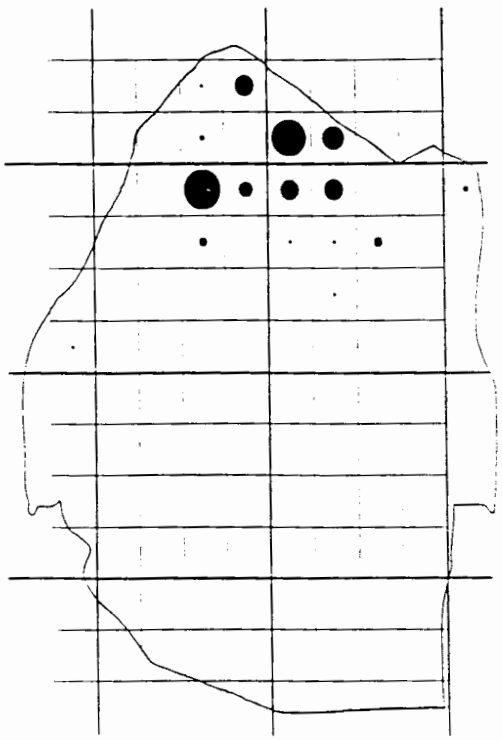


FIG 2d. YELLOWFRONTED TINKER BARBET
(Goodness of fit stat: gf1=1.02)

OBSERVED DISTRIBUTION



PREDICTED DISTRIBUTION



This predicted distribution does not represent the best fitting model derived for this species (Table 5) but was selected to illustrate the fit of a model for which gf1=1.

CHAPTER 2

MODELLING THE DISTRIBUTION OF BIRDS IN SWAZILAND IN RELATION TO ENVIRONMENTAL VARIABLES

SUMMARY

Logistic regression was used to model the observed geographical distributions of 335 bird species in Swaziland in relation to variables representing the geology, topography, climate and vegetation types of the study area. Reporting rates were used to represent the relative densities of the species. For each species, the variables which are significantly associated with the distributions were identified. The combination of geological, topographic and climatic variables was found to account more fully for the variation in relative densities than the vegetation types. The models accurately predicted the observed distributions of the bird species.

INTRODUCTION

Previous attempts to use statistical models (including logistic models) to relate the distribution of animal species to environmental variables have been made using presence/absence data to represent the distributions (e.g. Root 1988; Walker 1990; Osborne & Tigar 1992). In this study, the relative densities of the species, as represented by reporting rates (Underhill et al. 1992), are taken into account in using the method of logistic regression.

The Kingdom of Swaziland contains a diversity of habitats within a small area. The Swaziland Bird Atlas (Appendix 2) represents a set of bird distribution data which has several properties which make it particularly suitable for interpretation and statistical analysis. In particular, the fact that coverage was comprehensive and more even than for other atlas schemes in the region and that relatively few observers were involved, contribute to making the representation of relative densities

by reporting rates tenable.

METHODS

For each of 335 bird species which had been observed at least 20 times during the period 1985-1991, reporting rates for 98 one eighth degree grid squares were obtained from the Swaziland Bird Atlas (Appendix 2). Distributions were mapped on a finer scale (a one eighth degree grid) than for other atlas schemes in the region. For example, the Southern African Bird Atlas Project used a quarter degree grid, except for Botswana where a half degree grid was used (Harrison 1992). Coverage was also more comprehensive (at least 12 substantial field cards for each grid square) and more even than for other atlas schemes in the region. Most of the data was accumulated by the author, making it possible to eliminate the possible effects of observer bias from the analysis.

The method of logistic regression was used to model the reporting rates of each species in relation to a set of environmental variables (Chapter 1). Logistic regression is a method of generalized linear modelling which has been developed specifically for the modelling of binomial variables such as reporting rates (McCullagh & Nelder 1989). The method has previously been used to model bird atlas data by Osborne & Tigar (1992) but they reduced their data to a binary (presence/absence) variable and thus failed to make optimal use of the method. Support for the use of reporting rates as an index of relative abundance has been expressed by Bruderer & Bruderer (1993), Robertson et al. (in press) and D.G. Allan (pers. comm.). Fifteen environmental variables for which data were available at the appropriate scale were entered into the models as possible explanatory variables (Table 1). The vegetation types classification of Goudie & Price-Williams (1979) was used in preference to Acock's (1975) because it accounted for more of the variation in reporting rates (Chapter 1). Observer effort (the number of field cards returned per grid square) was included as an explanatory variable because for those grid squares where the number of visits (field cards) was much greater than the minimum, extra visits were concentrated at specific localities, causing the

reporting rates to be inflated for some species and deflated for others. Latitude and longitude were included as surrogates for climatic variables for which data were not available (particularly temperature). Temperatures decrease with latitude and also vary with longitude because the Indian Ocean which lies 50 km to the east exerts a moderating influence.

For each species, the distribution was modelled against the explanatory variables individually to determine whether the variable was significantly associated with the relative densities. The criteria for determining whether the association was significant were a value for the Wald statistic (t) greater than two and an associated change in deviance greater than five. These criteria were adopted after experimentation in fitting and cross validating the models had shown that the inclusion of variables which satisfied these criteria invariably improved the fit of the models, and this was not true of those that did not satisfy the criteria (Chapter 1). The set of variables significantly associated with the relative densities for each bird species was tabulated. A model selection procedure was used to fit a combined model and an abiotic model (excluding the vegetation types) for each species. The tabulation of significant variables was based on the univariate models rather than the combined models because in the combined models variables which were in fact strongly associated with the relative densities were eliminated in the selection procedure because they were correlated with a combination of the other variables.

A jack-knifing technique (Chapter 1) was used to predict the reporting rate for each square from a model based on the remaining squares. Two goodness of fit statistics (Chapter 1) based on the discrepancies between the observed and predicted values were calculated for each model. The first of these, the ratio between the sum of prediction residuals and the total deviance of the model, is used to assess the relative goodness of fit of the models. The fit of the models is considered good when this ratio exceeds one (Chapter 1). The second statistic is the ratio of the sum of prediction residuals to the sum of residuals of the full model. It reflects how far the predicted values differ from the fitted values.

The Knysna Lourie *Tauraco corythaix* and Livingstone's Lourie *T. livingstonii* were regarded as a

single species at the time of the field work. Because the two forms are geographically separated within Swaziland (Appendix 2), it was possible to model them both as a single species and as separate species. If the fit of the models differed much for these options, this might shed additional light on the taxonomic status of the species.

RESULTS

For all but one of the species modelled, the reporting rates were found to be significantly associated with two or more of the environmental variables (Table 2). For the Black Sparrowhawk *Accipiter melanoleucus* only rainfall was significantly associated. In cases where the change in deviance associated with a single variable is more than half that for the combined model, these variables are indicated in the table as highly significant. Each of the variables available was found to be associated with the reporting rates of at least 44% of the species (Table 3).

The amount of the total variation in reporting rates accounted for by each model as well as the goodness of fit statistics are reported in Table 4. The abiotic models accounted for more of the variation in relative densities than the vegetation types in 321 out of 335 cases. Vegetation types were included in the combined model for 195 species and excluded for 139. The inclusion of vegetation types in the combined model improved the fit of the model in 61 cases. Of the 11 species for which the fit of the models was relatively poor (i.e. the first goodness of fit statistic less than one), eight were water birds.

Comparison between the observed and predicted distributions for the Yellowfronted tinkerbarbet *Pogoniulus chrysoconus* illustrates the fit of a model for which the first goodness of fit statistic is close to one (Fig 1d). The success of the models in predicting the observed distributions is illustrated in Figure 1. These examples illustrate the fact that the models are able to account not only for the distribution boundaries of the species, but also for differences in relative densities within the ranges.

The predicted distribution for the Cape turtle dove *Streptopelia capicola*, deserves special attention (Fig 1a). The model has successfully predicted the gap in the distribution in the north west and this means that it has identified the combination of factors among the environmental variables which make the locality particularly unfavourable. Examination of the values of the variables included in the model for those squares where the predicted densities are low reveals that the variables which combine to create relatively unfavourable conditions for the species are the geological profile, absence of major river valleys and the incidence of large areas of exotic timber plantations. No single variable can account for the observed gap in the distribution.

In the case of the Knysna and Livingstone's Lourie, there was little difference in the goodness of fit of the models whether or not the two were treated as distinct species. There was also little difference in the sets of variables which were found to be significant in the respective models. The most noticeable difference among the variables was in the significance and the coefficients of the variables representing latitude and longitude, which simply reflects the observed fact that the two forms are geographically separated. This result therefore does not shed any light on the taxonomic status of the species.

DISCUSSION

The fact that the fit of the models was remarkably good in most instances indicates that the variables successfully accounted for much of the variation in relative densities of the species. For species which are relatively inconspicuous or scarce or both, a greater proportion of the variation in reporting rates may be expected to be random and the models were expected to fit less well. This is in fact observed e.g. for the Black Sparrowhawk, *Accipiter melanoleucus,* African Goshawk *A. tachiro*, Hobby falcon *Falco subbuteo*, Eastern Redfooted Kestrel *F. amurensis* and the Water Dikkop *Burhinus vermiculatus* (Table 4).

The fact that eight of the 11 species for which the models fitted relatively poorly were water birds

suggests that the nature and extent of wetlands are the environmental factors which the variables used least adequately account for. Although the occurrence of timber plantations and of intensive agriculture in the form of sugar, citrus and cotton plantations were included, the variables used do not adequately account for habitat modification due to human activities. This factor may account for the relative poorness of fit for several species which are not waterbirds and neither scarce nor inconspicuous, including the Common Waxbill *Estrilda astrild*, Thickbilled Weaver *Amblyospiza albifrons*, Paradise Flycatcher *Terpsiphone viridis*, Kurrichane Thrush *Turdus libonyana*, Southern Black Tit *Parus niger* and Blackheaded Oriole *Oriolus larvatus*. Among the passerines, the species for which the model shows the poorest fit is the Squaretailed Drongo *Dicruris ludwigii.* The species occurs in natural forests in the middleveld and Lubombo regions (Appendix 2). It is likely that the degradation of natural forests has adversely affected the species and this may account for the failure of the model to explain its distribution. Examples of species which have benefitted from human activities and for whom the fit of the models was relatively poor are the Palm Swift *Cypsiurus parvus* which occurs in association with exotic palm trees (Maclean 1985), the Whitefronted Bee-eater *Merops bullockoides* which is most numerous where exotic gum trees occur in the vicinity of erosion gullies (Appendix 2) and the House Sparrow *Passer domesticus* which occurs exclusively in association with human settlements (Maclean 1985).

Care needs to be taken in interpreting the associations between the variables and the species distributions. For example, Table 2 indicates a significant positive association with exotic timber plantations for the Bald Ibis *Geronticus calvus*. It would be erroneous to deduce that the species occurs within, utilises, or in any way benefits from the plantations. What the association does indicate is that the species occurs in a habitat that is suitable for the establishment of plantations. The species has in fact been adversely affected by plantations because much of its former habitat has been replaced by them. Similarly, where a species is positively associated with nature reserves, it cannot be assumed that it necessarily benefits from the reserves. It is possible that the distribution of the species coincides to some extent with that of the reserves without the species necessarily occurring at greater density within the reserves than outside. For example,

the Longtailed Shrike *Corvinella melanoleuca* shows a positive association with nature reserves because it occurs in the same grid squares as the nature reserves in the lowveld but it occurs almost exclusively outside the reserves. On the other hand, the two species for which nature reserves are identified as highly (positively) significant in the table (Table 3) (Marabou stork *Leptoptilos crumeniferus* and Redbilled Oxpecker *Buphagus erythrorhynchus*) were in fact encountered far more often within the reserves than without.

The one species for which timber plantations were identified as having a highly significant positive association (Table 3) is the Green Twinspot *Mandingoa nitidula* which in fact occurs primarily in high altitude natural forests and some wattle plantations but not in pine or gum plantations. The very strong association with plantations is due to the fact that plantations are invariably found in the vicinity of natural forests in the highveld.

The nineteen species which are highly negatively associated with timber plantations (Table 3) are all species which occur either exclusively in the lowveld or more often in the lowveld than the highveld. Since timber plantations occur exclusively in the highveld, these associations are due to the correlation between plantations and altitude and not to any direct impact of the plantations.

The five species which were indicated as being highly significantly positively associated with intensive agriculture (Table 3) are the Cuckoo Hawk *Aviceda cuculoides*, Longcrested Eagle *Lophaetus occipitalis*, Hobby Falcon *Falco subbuteo*, Palm Swift and African Marsh Warbler *Acrocephalus baeticatus*. For the Cuckoo Hawk, the association is probably due to it being more conspicuous when foraging in cultivated lands than in its more natural woodland habitats. For the Palm Swift, the association is due to the fact that most of the major agricultural estates have ornamental palm trees around their head offices. On the other hand, the Longcrested Eagle, Hobby Falcon and African Marsh Warbler probably were more numerous in the cultivated lands than elsewhere in the study area.

More species were both highly significantly and significantly negatively associated with rainfall than positively. This illustrates the greater species diversity found in the lowveld (which is a low rainfall region) than the highveld. In the highveld, high rainfall together with steep gradients combine to cause leaching of the soil to a greater extent than in the flat arid lowveld. This contributes to a discrepancy in mineral wealth of the soil, with the richer soils in the lowveld supporting a greater diversity of plant and animal life.

A number of species which are normally associated with grassland (Rufousnaped Lark *Mirafra africana*, Fantailed Cisticola *Cisticola juncidis*, Redfaced Cisticola *Cisticola erythrops*, Croaking Cisticola *Cisticola natalensis*, Richard's Pipit *Anthus novaeseelandiae*, Yellowthroated Longclaw *Macronyx croceus*, Redshouldered Widow *Euplectes axillaris*, Whitewinged Widow *Euplectes albonotatus*, Blue Waxbill *Uraeginthus angolensis*, Quail Finch *Ortygospiza atricollis*, Yelloweyed Canary *Serinus mozambicus*, Bluebilled Firefinch *Lagonosticta rubricata*, Bronze Mannikin *Spermestes cucullatus*, Pintailed Whydah *Vidua macroura* and Black Widowfinch *Vidua funerea*) showed negative associations with nature reserves. This may be a reflection of severe habitat degradation which has occurred in reserves in the lowveld as a result of non-cull policies and consequent overgrazing (Appendix 2).

For some species, more insight into the nature of the associations was gained during the model selection process. For example, for the Longtailed widow *Euplectes progne*, the variable representing nature reserves remained highly significant after being combined with the other variables. Moreover, exclusion of this variable from the model resulted in a 17% poorer fit of the model (as measured by the sum of prediction residuals (Chapter 1)). This points to the fact that the species does indeed occur at far higher density within the one highveld nature reserve than elsewhere, which in turn points to the degradation of highveld grasslands and marshes due to grazing pressure.

For the Giant Kingfisher *Ceryle maxima*, the fact that the variable representing rivers was the only highly positively significant variable in the model aptly describes the habitat requirements of the

species. For the Little Bee-eater *Merops pusillus*, the variable representing rivers narrowly failed to meet the criterion for highly significant (positive). This brings to light the fact not previously appreciated, that the species was observed more often in river valleys than elsewhere in the study area.

Where an association with the variable representing the occurrence of streams is indicated, this generally does not indicate whether or not the species occurs most frequently along or in the vicinity of streams. Rather, this variable reflects conditions relating to the topography and soil structure in the study area.

Two species which are usually encountered on cliffs, the Cape Rock Thrush *Monticola rupestris* and the Mocking Chat *Thamnolaea cinnmomeiventris*, are not significantly associated with the variable representing altitude range. This variable represents changes in altitude over the area of a grid square (approximately 12 km by 12) and is apparently not sensitive to sharp changes in altitude over short distances.

The Longtailed Wagtail *Motacilla clara* is one of four species for which altitude range is highly significant. It occurs along narrow fast flowing streams, and steep gradients are indeed part of its habitat requirements. The other three, Pygmy Kingfisher *Ispidina picta*, Redthroated Wryneck *Jynx ruficollis* and House Martin *Delichon urbica*, are relatively scarce species which were encountered in a range of different habitats and the fit of the models for these species was relatively poor with values of the first goodness of fit statistic below 1.5 (Table 3). The altitude range shows up as highly significant for these species partly because no other variables are particularly significant for them. It does nevertheless indicate that these species were observed more often in hilly terrain than elsewhere.

The relatively poor fit of the model for the Yellowfronted Tinkerbarbet (Fig. 1d) is partly due to its presence being predicted in grid squares to the east of its observed distribution. Its absence from

those grid squares may be explained by its replacement by a similar species, the Redfronted Tinkerbarbet *Pogoniulus pusillus* (Appendix 2). This is a factor not taken into account in the regression analysis.

For 95% of the species, the abiotic model was more successful than the vegetation types in explaining the observed relative densities. This indicated that the relative densities vary within vegetation types and that this variation is explained by variation in topography, geology and climate. The vegetation type classification referred to classifies the vegetation regions with respect to species composition and disregards differences in structure of the vegetation within the vegetation types (l'ons 1967). An alternative vegetation type classification which takes into account the differences in structure as well as the species composition of the vegetation would conceivably perform at least as well as the abiotic models used here in explaining the geographical distribution of the birds.

For 61 species (18%) the addition of vegetation types to the abiotic models improved the fit of the models. This suggests that the abiotic variables used have not captured all of the factors which determine the vegetation types.

Whereas univariate models were used to identify variables which are significantly associated with the relative densities, the example of the Cape Turtle Dove (Fig. 1a) illustrates that the combined models can throw additional light on how the individual variables combine to create favourable or unfavourable conditions for a species.

Although the models have successfully identified explanatory variables for all 335 species, the fact that data collection was conducted on a grid square basis rather than a habitat basis leads to difficulties in interpreting these results. Many of the associations between species distributions and environmental variables may be due to correlations between the explanatory variables.

TABLE 1

CODING OF THE ENVIRONMENTAL VARIABLES

VARIABLE	EXPLANATION
ALTITUDE	The median of the altitudes read at the north eastern corner of each of 40 random 1x1 km quadrats.
ALTITUDE RANGE (ABS)	The absolute range of the altitudes read at the north eastern corner of each of the 40 random quadrats.
ALTITUDE RANGE (IQ)	The interquartile range of the altitudes read at the north eastern corner of each quadrat.
RAIN	The mean of the estimated mean annual rainfall values for each minute of latitude by longitude.
STREAMS	The number of random quadrats which contain at least 0.5 km of stream.
CARDS	The number of field cards accumulated for the square.
GEOLOGY	The value for each of the six variables is the proportion of the square which is assigned to the corresponding geological type in the map by Goudie & Price-Williams (1979).
RIVERS	The number of random quadrats which intersect a river at least 5 m in width.
PLANTATIONS	The proportion of the square which is covered by exotic timber plantations.
AGRICULTURE	The proportion of the square which is utilized for intensive cultivation of sugar, cotton or citrus.
LATITUDE	The latitude in minutes of the southern boundary of the square.
LONGITUDE	The longitude in minutes of the western boundary of the square.
VEGETATION TYPE	The value for each of the 11 variables is the proportion of the square which is assigned to the corresponding vegetation type in the map by Goudie & Price-Williams (1979).
DAMS	A binary variable representing the presence or absence of artificial impoundments.
FORESTS	A binary variable representing the presence or absence of natural forests.
NATURE RESERVES	The proportion of the square which falls within a nature reserve.

TABLE 2

ENVIRONMENTAL VARIABLES ASSOCIATED WITH THE DISTRIBUTION OF BIRD SPECIES

KEY: p = POSITIVE ASSOCIATION
n = NEGATIVE ASSOCIATION
0 = NO SIGNIFICANT ASSOCIATION
ENTRIES IN CAPITAL LETTERS (P,N) DENOTE THAT THE VARIABLE ACCOUNTS FOR MORE THAN HALF OF THE VARIATION ACCOUNTED FOR BY THE COMBINED MODEL

KEY TO THE COLUMNS:

COLUMN	VARIABLE
1	VEGETATION TYPE (V)
2	GEOLOGY (G)
3	ALTITUDE (Al)
4	RAINFALL (Ra)
5	DAMS (D)
6	RIVERS (Ri)
7	FIELDCARDS (C)
8	PLANTATIONS (P)
9	STREAMS (S)
10	LATITUDE (La)
11	LONGITUDE (Lo)
12	INTENSIVE AGRICULTURE (I)
13	FOREST (F)
14	NATURE RESERVES (N)
15	ALTITUDE RANGE (AR)

	V	G	A	RaD	RiC	P	S	LaLoI	F	N	AR
DABCHICK..	p	p	p	0	p	n	0	0	0	0	0	p	p	p	0
WHITBRST CORMORANT..	P	0	p	0	p	0	0	0	0	n	0	0	0	0	n
REED CORMORANT..	p	p	n	n	p	p	0	0	0	n	0	p	n	0	n
DARTER..	p	p	p	p	P	0	p	n	p	n	p	n	n	0	n
GREY HERON..	p	p	n	n	p	p	0	n	n	0	p	p	n	0	0
BLACKHEADED HERON..	P	p	p	0	p	0	p	0	n	p	n	p	0	0	n
PURPLE HERON..	p	p	n	n	p	0	0	n	n	n	p	p	n	0	n
GREAT WHITE EGRET..	P	p	N	n	P	n	p	n	n	0	p	p	n	0	p
LITTLE EGRET..	p	p	n	n	p	0	0	n	n	0	p	p	n	0	n
CATTLE EGRET..	p	p	n	n	p	p	n	n	0	p	n	0	n	0	n
SQUACCO HERON..	P	p	N	n	p	0	0	n	n	0	p	p	n	0	n
GREENBACKED HERON..	p	p	N	n	p	p	0	n	n	n	p	p	n	0	0
HAMERKOP..	p	p	n	n	p	p	n	n	n	p	0	p	n	0	0
WHITE STORK..	P	p	p	0	0	0	0	0	0	p	0	0	0	0	0
BLACK STORK..	P	P	n	n	p	0	0	n	n	0	P	p	0	0	p
WOOLLYNECK STORK..	P	P	n	n	0	n	0	0	0	0	P	p	0	0	0
MARABOU STORK..	p	p	n	n	p	p	0	0	n	n	p	p	0	P	0
YELLOWBILL STORK..	P	P	N	n	p	0	0	n	n	0	p	p	n	0	0
SACRED IBIS..	P	p	0	0	p	0	0	0	0	p	0	p	0	0	n
BALD IBIS..	P	P	p	p	n	0	p	p	p	p	n	n	p	p	0
HADEDA IBIS..	P	p	p	0	0	p	p	p	0	p	n	0	n	p	n
AFRICAN SPOONBILL..	p	p	n	n	p	0	0	n	n	0	p	p	n	0	n
WHITEFACED DUCK..	P	p	n	n	P	p	0	n	n	n	p	p	n	0	n
EGYPTIAN GOOSE..	p	p	N	n	P	p	0	n	n	0	p	p	n	p	n
YELLOWBILLED DUCK..	p	p	p	p	p	n	p	p	p	0	n	n	p	p	n
AFRICAN BLACK DUCK..	p	p	p	0	p	p	0	p	0	0	n	0	0	p	n
REDBILLED TEAL..	p	p	n	n	p	0	p	n	n	0	p	p	n	p	n
PYGMY GOOSE..	p	p	n	n	p	p	p	n	0	0	p	p	0	0	0
KNOBBILLED DUCK..	P	P	n	n	P	0	0	n	n	0	p	p	n	0	0
SPURWINGED GOOSE.	p	p	n	n	p	n	p	n	n	0	0	p	0	p	n
SECRETARYBIRD..	P	p	p	p	n	0	p	0	p	0	n	0	p	p	0
WHITEBACKD VULTURE..	P	P	N	n	p	0	0	n	n	n	P	p	n	p	n
WHITHEADED VULTURE..	P	P	N	n	p	0	0	n	n	0	P	p	0	p	0
YLWBLD/BLACK KITE..	P	p	n	n	0	n	0	n	n	P	p	0	0	0	0
BLACKSHOULDRD KITE..	p	p	n	n	p	0	0	n	n	p	0	p	0	0	n

CUCKOO HAWK..	0	0	N	0	0	0	0	0	0	n	0	P	0	0	0
TAWNY EAGLE..	P	P	N	N	p	0	0	0	n	0	P	p	n	0	0
WAHLBERG EAGLE..	P	P	N	N	p	0	n	N	n	0	P	p	n	0	0
LONGCRESTED EAGLE..	P	p	n	n	p	0	0	0	n	n	p	P	0	p	0
MARTIAL EAGLE..	P	p	N	n	p	p	0	n	n	0	P	p	0	p	0
CROWNED EAGLE..	p	p	p	p	0	p	p	p	p	n	0	n	p	p	p
BROWN SNAKE EAGLE..	P	p	N	n	0	p	0	n	n	0	p	p	0	p	p
BATELEUR..	P	P	N	n	p	0	0	n	n	0	P	p	n	p	0
AFRICAN FISH EAGLE..	P	p	N	n	p	p	p	n	n	n	p	p	n	p	0
STEPPE BUZZARD..	P	p	p	0	n	0	0	0	0	p	n	n	0	n	0
JACKAL BUZZARD..	P	p	P	P	n	n	p	p	p	n	n	n	p	0	p
LIZARD BUZZARD..	P	P	N	n	p	p	n	n	n	0	P	p	n	0	0
REDBRS SPARROWHAWK..	P	0	P	p	n	0	0	p	p	0	N	n	0	0	0
BLACK SPARROWHAWK..	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0
AFRICAN GOSHAWK..	p	p	0	0	0	p	p	n	0	n	p	0	0	0	0
AFR MARSH HARRIER..	P	p	p	p	0	n	p	0	p	0	n	n	p	p	0
GYMNOGENE..	P	P	n	n	0	0	0	n	0	0	P	0	0	0	p
OSPREY..	P	p	N	n	p	0	0	n	n	0	P	p	n	0	n
LANNER FALCON..	P	0	P	0	0	0	0	0	0	0	n	0	0	0	0
HOBBY FALCON..	p	P	0	0	P	0	0	0	0	0	0	P	0	0	0
E REDFOOTD KESTREL..	P	P	p	0	0	0	0	0	0	p	n	0	0	0	n
ROCK KESTREL..	P	p	P	p	n	n	p	0	p	0	n	0	p	0	0
COQUI FRANCOLIN..	p	p	n	n	n	0	n	0	n	P	n	n	n	n	0
CRESTED FRANCOLIN..	P	p	N	N	p	p	n	N	n	p	P	p	n	0	0
SHELLEY FRANCOLIN..	p	p	n	n	n	p	n	n	0	p	0	n	0	n	0
REDWING FRANCOLIN..	P	p	P	P	n	0	p	0	p	n	n	n	p	p	p
NATAL FRANCOLIN..	P	p	p	p	0	0	0	p	p	n	0	0	p	p	p
SWAINSON FRANCOLIN..	P	p	p	0	n	p	0	p	p	p	n	n	0	0	0
COMMON QUAIL..	0	P	0	n	0	0	0	0	0	P	0	0	0	0	0
HELMETD GUINEAFOWL..	P	p	N	n	p	p	n	n	n	0	p	p	n	p	n
CRESTED GUINEAFOWL..	p	P	n	n	p	0	0	n	0	n	P	0	p	p	p
KRRCHN BUTTONQUAIL..	P	P	n	n	0	0	0	n	n	0	p	p	0	0	0
BLACK CRAKE..	P	p	n	n	P	0	0	n	n	n	p	p	0	0	0
MOORHEN..	p	p	n	n	p	0	p	n	n	0	p	p	0	0	0
REDKNOBBED COOT..	p	p	p	p	p	n	p	p	p	0	n	n	p	p	n
WHITEBELLD KORHAAN..	P	p	p	0	n	0	n	p	0	p	n	n	0	n	n
REDCRESTED KORHAAN..	P	p	n	n	p	0	n	n	n	p	p	p	n	0	n
BLACKBELLD KORHAAN..	P	p	n	n	0	0	0	n	n	p	p	p	0	p	0
AFRICAN JACANA..	P	p	n	n	P	0	0	n	n	n	p	p	0	p	p
KITTLITZ'S PLOVER..	P	p	N	n	p	p	0	n	n	0	p	p	n	0	n
THREEBANDED PLOVER..	P	p	n	N	p	p	n	n	n	p	p	p	n	0	n
CROWNED PLOVER..	P	p	n	N	p	p	n	n	n	p	p	p	n	n	n
LSR BLKWNGD PLOVER..	p	p	N	n	p	0	0	n	n	n	p	p	n	0	n
BLCKWNGD PLOVER..	P	p	P	p	n	n	p	p	p	0	n	n	p	0	p
BLACKSMITH PLOVER..	p	p	n	n	P	n	0	n	n	0	p	p	n	p	n
WATTLED PLOVER..	P	P	p	p	p	p	0	p	p	0	n	n	n	0	n
COMMON SANDPIPER..	P	p	n	n	p	p	n	n	n	0	p	p	n	p	0
WOOD SANDPIPER..	P	p	n	n	P	0	0	n	n	0	p	p	n	p	n
MARSH SANDPIPER..	P	p	N	n	p	p	0	p	n	0	p	p	n	0	n
GREENSHANK..	p	p	n	n	P	0	0	n	n	0	p	p	n	0	n
CURLEW SANDPIPER..	p	p	n	n	P	0	0	n	n	0	p	p	n	0	0
LITTLE STINT..	P	p	n	n	p	0	0	n	n	0	p	p	n	p	n
RUFF..	p	p	n	n	p	0	p	n	n	0	p	p	n	0	n
ETHIOPIAN SNIPE..	P	P	p	p	0	n	p	0	0	0	n	0	0	p	n
BLACKWINGED STILT..	p	p	n	n	p	p	p	n	n	0	p	p	n	0	n
SPOTTED DIKKOP..	P	P	0	n	0	0	n	0	0	p	p	0	n	0	n
WATER DIKKOP..	P	0	n	n	p	p	0	n	n	n	0	0	n	p	n
GREYHEADED GULL..	p	0	n	n	P	0	0	n	0	n	p	p	n	0	n
ROCK PIGEON..	P	P	P	p	0	0	0	p	p	p	N	n	0	0	0
RAMERON PIGEON..	P	p	P	P	n	0	p	p	P	n	n	n	p	0	p
REDEYED DOVE..	P	p	n	n	0	p	n	0	0	0	p	p	n	n	p
CAPE TURTLE DOVE..	P	p	n	n	0	p	n	n	n	p	n	0	n	n	0
LAUGHING DOVE..	P	p	n	N	p	p	n	n	n	p	p	p	n	n	n
NAMAQUA DOVE..	P	P	N	N	p	0	0	n	N	p	p	p	n	0	0

GREENSPOTTED DOVE..	P	p	N	n	0	p	n	n	n	p	p	p	n	n	p
TAMBOURINE DOVE..	P	p	N	n	0	p	n	n	n	0	p	p	0	0	p
GREEN PIGEON..	p	p	n	n	p	p	n	n	n	n	p	p	n	p	p
BROWNHEAD PARROT..	P	P	N	n	p	n	0	n	n	p	p	p	n	p	0
KNYSNA LOURIE..	p	p	p	p	0	n	p	0	p	n	p	0	P	p	p
PURPLECREST LOURIE..	P	p	n	n	p	0	n	n	n	n	p	p	0	p	p
GREY LOURIE..	P	P	N	n	p	n	n	n	n	p	p	p	n	p	n
AFRICAN CUCKOO..	P	p	N	N	p	0	0	n	n	p	p	p	n	0	n
REDCHESTED CUCKOO..	P	P	P	p	0	0	0	0	p	0	n	n	0	0	0
BLACK CUCKOO..	P	P	p	0	0	0	0	0	0	0	N	n	0	0	0
EMERALD CUCKOO..	P	p	P	0	n	n	0	0	p	0	0	0	p	0	p
KLAAS'S CUCKOO..	P	p	N	n	0	p	n	n	n	0	p	p	n	0	p
DIEDERIK CUCKOO..	P	p	n	N	p	p	n	n	n	p	0	0	N	0	n
BURCHELL'S COUCAL..	P	p	N	n	p	p	n	n	n	0	P	p	n	0	p
SCOPS OWL..	P	p	N	n	p	0	p	n	n	0	p	p	n	p	n
PEARLSPOTTED OWL..	P	P	N	n	p	0	0	0	n	p	p	p	n	p	0
FIERYNCK NIGHTJAR..	p	p	n	n	p	p	0	0	n	0	p	p	n	0	0
MOZAMBQ NIGHTJAR..	p	p	n	n	p	0	n	0	n	p	p	p	n	0	0
BLACK SWIFT..	P	p	0	P	0	0	p	p	p	n	n	0	p	p	p
WHITERUMPED SWIFT..	p	0	0	p	0	p	0	0	p	n	0	0	0	0	0
HORUS SWIFT..	P	P	P	p	n	0	0	p	p	p	n	n	0	0	p
LITTLE SWIFT..	p	p	n	n	p	p	0	n	n	0	p	p	n	p	n
PALM SWIFT..	p	p	n	0	p	p	0	0	n	n	p	P	0	0	n
SPECKLED MOUSEBIRD..	P	p	p	0	n	p	n	0	0	0	0	0	0	n	p
REDFACED MOUSEBIRD..	P	p	N	N	p	p	n	n	n	p	p	p	n	0	0
NARINA TROGON..	P	P	P	p	n	n	0	p	p	n	0	n	P	0	p
PIED KINGFISHER..	p	p	n	n	p	p	0	n	n	n	p	p	n	p	0
GIANT KINGFISHER..	p	p	0	0	p	P	0	0	0	n	0	0	0	p	0
HLFCLRD KINGFISHER..	P	p	0	p	0	p	0	p	p	n	n	0	p	p	p
MLCHITE KINGFISHER..	P	p	n	n	P	0	0	n	n	0	p	p	n	0	n
PYGMY KINGFISHER..	0	P	0	p	0	0	0	0	0	N	0	0	0	0	P
WOODLND KINGFISHER..	P	p	N	n	p	0	0	0	n	n	P	p	n	p	0
BRWNHD KINGFISHER..	P	p	n	n	0	p	n	n	n	p	p	0	n	n	p
STRIPED KINGFISHER..	P	p	N	n	p	0	n	n	n	0	P	p	n	p	0
EUROPEAN BEE-EATER..	P	p	N	n	0	p	n	N	n	0	P	p	n	0	p
WHTFRNT BEE-EATER..	p	p	n	n	p	p	n	n	n	0	0	p	n	n	0
LITTLE BEE-EATER..	p	p	n	n	0	p	n	n	0	0	p	p	n	0	0
EUROPEAN ROLLER..	P	P	N	N	p	0	0	n	N	p	P	p	n	0	0
LILACBRSTED ROLLER..	P	P	N	N	p	0	n	n	N	p	P	p	n	p	n
HOOPOE..	P	p	N	N	p	0	n	n	n	0	p	p	n	0	n
REDBLLD WOODHOOPOE..	P	p	N	n	p	p	n	n	n	0	P	p	n	p	0
SMTRBLD WOODHOOPOE..	P	P	N	N	p	p	n	N	n	p	p	p	n	p	0
TRUMPETER HORNBILL..	P	P	n	0	0	n	0	n	0	n	p	p	p	p	p
GREY HORNBILL..	P	P	N	n	p	0	0	n	n	0	P	p	n	p	0
REDBILLED HORNBILL..	P	P	N	n	p	0	0	0	n	0	p	p	0	p	0
YELLOWBLD HORNBILL..	P	P	N	N	p	0	n	0	n	p	p	p	n	p	n
CROWNED HORNBILL..	P	P	n	0	n	0	n	n	0	0	P	0	p	0	p
BLACKCOLLRD BARBET..	P	p	n	n	0	p	n	n	0	0	p	0	0	n	p
PIED BARBET..	P	P	N	N	p	n	n	0	N	p	p	p	n	0	n
RDFRT TNKER BARBET..	P	p	n	n	p	0	n	n	n	p	p	0	n	0	p
YLWFT TNKER BARBET..	P	p	n	0	p	p	n	n	0	n	0	0	n	0	0
GLDRP TNKER BARBET..	P	p	n	p	p	0	0	0	0	N	p	p	p	0	p
CRESTED BARBET..	P	p	n	n	p	p	n	n	n	p	p	p	n	0	p
GREATER HONEYGUIDE..	p	p	n	n	p	p	0	n	n	0	p	p	0	p	0
SCYTHRT HONEYGUIDE..	P	p	p	p	n	0	0	0	0	n	0	0	p	0	p
LESSER HONEYGUIDE..	P	p	0	0	0	p	0	p	0	n	0	p	0	0	p
SHRPBLD HONEYGUIDE..	P	p	P	p	0	0	p	p	p	0	n	0	0	0	0
GROUND WOODPECKER..	p	p	P	p	n	0	p	p	p	n	N	0	p	0	0
BENNETT WOODPECKER..	P	P	N	n	p	0	0	0	n	0	P	p	0	p	0
GLDNTLD WOODPECKER..	P	p	N	n	p	p	n	n	n	0	P	p	n	p	p
CARDINL WOODPECKER..	P	p	N	N	p	p	n	n	n	0	P	p	n	p	0
BEARDED WOODPECKER..	P	p	N	n	p	0	n	0	n	0	P	p	n	p	0
OLIVE WOODPECKER..	P	p	p	P	n	n	p	p	p	n	n	n	p	0	p
REDTHROATD WRYNECK..	P	p	p	0	0	p	0	0	p	0	n	0	0	0	P

RUFOUSNAPED LARK..	P	p	n	n	n	p	N	0	0	p	0	n	n	n	0
FLAPPET LARK..	P	P	n	n	0	n	0	0	n	0	P	p	p	0	p
SABOTA LARK..	P	p	N	N	p	0	n	0	n	p	p	p	n	0	n
REDCAPPED LARK..	P	p	p	0	n	0	n	p	0	p	n	0	0	n	n
EUROPEAN SWALLOW..	P	p	n	N	0	0	N	N	n	p	p	0	n	0	0
WHITETHRTD SWALLOW..	P	P	P	p	0	0	p	p	p	0	N	n	p	0	n
BLUE SWALLOW..	P	p	P	p	n	n	p	0	p	n	n	0	p	p	p
WIRETAILED SWALLOW..	p	p	n	n	p	p	n	n	n	n	p	p	n	0	p
REDBREASTD SWALLOW..	P	p	n	n	0	p	n	n	n	p	p	0	n	n	0
GRTR STRPD SWALLOW..	P	P	P	p	n	0	p	p	p	0	N	0	0	0	0
LSR STRIPD SWALLOW..	P	p	N	n	p	p	n	n	n	0	p	p	n	0	p
ROCK MARTIN..	P	P	p	p	0	n	n	0	p	n	0	n	p	p	p
HOUSE MARTIN..	p	P	0	p	0	0	0	0	P	0	n	0	0	0	P
GREYRUMPED SWALLOW..	P	P	p	p	p	p	0	n	p	n	n	0	p	0	p
BROWNTHRTED MARTIN..	P	p	p	0	0	p	n	p	0	p	n	0	0	n	n
BANDED MARTIN..	P	p	P	p	0	n	p	p	p	0	n	0	p	p	0
BLK SAWWNG SWALLOW..	P	P	P	P	n	0	p	p	p	n	N	n	p	n	p
BLACK CUCKOOSHRIKE..	P	p	n	n	p	p	n	n	n	0	p	p	n	0	0
FORKTAILED DRONGO..	P	p	n	n	0	p	n	0	n	p	0	0	n	n	n
SQUARETAILD DRONGO..	P	p	n	p	0	n	p	p	p	n	p	n	p	0	p
BLACKHEADED ORIOLE..	P	p	n	n	0	p	n	p	n	0	0	0	n	0	0
BLACK CROW..	P	p	P	0	n	n	0	p	p	p	N	0	0	0	n
PIED CROW..	P	p	n	n	0	n	n	n	n	p	p	p	0	n	p
WHITENECKED RAVEN..	P	p	p	P	n	n	p	p	p	n	n	0	p	0	p
SOUTHERN BLACK TIT..	P	p	n	n	0	p	n	n	n	p	p	0	n	0	n
GREY PENDULINE TIT..	P	p	N	n	p	p	n	N	n	0	p	p	n	p	0
ARROWMARKD BABBLER..	P	p	N	N	p	0	n	n	n	p	p	p	n	0	0
BLACKEYED BULBUL..	p	p	n	n	n	p	N	0	0	p	0	0	n	n	p
TERRESTRIAL BULBUL..	P	p	N	n	0	0	n	n	n	0	P	p	0	n	p
SOMBRE BULBUL..	P	p	n	n	0	p	n	n	0	0	p	0	0	n	p
YELLOWSPTD NICATOR..	P	p	n	n	0	0	n	n	n	0	p	0	0	0	p
KURRICHANE THRUSH..	P	p	n	n	n	p	n	0	n	0	0	0	n	0	0
OLIVE THRUSH..	P	P	P	p	0	0	p	p	p	n	n	0	p	0	0
GRNDSCRAPER THRUSH..	P	p	n	n	0	0	n	n	n	p	p	p	n	n	n
CAPE ROCK THRUSH..	P	p	P	P	n	0	p	p	p	n	N	n	p	0	0
MOUNTAIN CHAT..	P	p	p	0	n	0	n	p	p	p	n	0	n	n	n
BUFFSTREAKED CHAT..	P	p	P	p	n	0	p	p	p	n	N	0	p	0	0
FAMILIAR CHAT..	P	P	P	P	n	p	p	p	p	0	n	n	p	0	p
MOCKING CHAT..	P	p	P	p	n	0	p	p	p	0	N	0	0	0	0
STONECHAT..	P	p	P	p	0	0	p	p	p	n	n	n	p	0	0
CHORISTER ROBIN..	P	P	P	P	n	0	p	p	p	n	N	0	p	0	p
HEUGLIN'S ROBIN..	P	p	n	n	0	p	n	n	n	0	p	p	n	n	p
NATAL ROBIN..	P	p	n	0	n	n	0	0	p	0	p	0	p	0	p
CAPE ROBIN..	P	p	P	p	n	0	p	p	p	0	N	n	p	n	p
WHITETHROATD ROBIN..	P	p	n	n	0	0	n	n	n	0	P	p	0	0	p
WHITEBROWED ROBIN..	P	p	N	N	0	p	n	n	n	p	P	p	n	0	p
AFR MARSH WARBLER..	P	P	n	n	p	0	0	n	n	0	p	P	n	0	n
ERPN MARSH WARBLER..	P	p	N	n	0	0	n	N	n	p	p	p	n	n	0
CAPE REED WARBLER..	p	p	n	n	p	0	0	0	n	0	p	p	n	0	n
YELLOW WARBLER..	P	P	P	p	0	0	p	0	p	0	N	0	0	0	0
AFR SEDGE WARBLER..	P	P	n	n	p	p	0	0	0	0	p	p	0	0	n
BROADTAILD WARBLER..	P	p	p	p	0	0	p	0	p	0	n	0	P	p	0
WILLOW WARBLER..	P	p	0	n	0	0	0	0	n	0	0	0	n	0	p
YELLWTHRTD WARBLER..	P	P	p	P	0	0	p	0	p	n	n	0	P	0	p
BARTHROATED APALIS..	P	p	P	p	n	0	p	p	p	0	n	n	p	n	p
YELLOWBRSTD APALIS..	P	p	N	n	p	0	n	n	n	0	P	p	n	0	p
RUDD'S APALIS..	P	P	N	N	0	0	n	0	N	p	p	p	n	0	0
LONGBILLED CROMBEC..	P	p	N	N	p	0	n	N	n	p	P	p	n	0	0
YLLWBLLD EREMOMELA..	P	p	N	N	p	0	n	0	n	0	P	p	n	0	0
BLEATING WARBLER..	P	p	n	n	0	0	n	n	n	0	p	0	0	n	p
STRLG BRRD WARBLER..	P	p	N	N	p	p	n	0	n	p	p	p	n	n	0
GRASSBIRD..	P	p	P	p	n	0	p	p	p	0	N	n	p	n	0
FANTAILD CISTICOLA..	P	p	0	n	0	0	n	n	0	P	0	0	n	n	n
DESERT CISTICOLA..	P	P	n	n	n	n	n	0	n	p	p	0	n	0	0

AYRES' CISTICOLA..	P	P	P	p	n	0	p	p	p	0	N	0	p	0	0
WAILING CISTICOLA..	P	p	P	P	n	n	p	p	p	n	N	0	p	0	p
RATTLING CISTICOLA..	P	p	N	N	p	p	n	N	n	p	P	p	n	0	0
REDFACED CISTICOLA..	P	p	N	n	0	p	n	n	n	0	p	p	n	n	p
LEVAILNT CISTICOLA..	P	P	P	p	n	n	p	p	p	p	N	n	p	0	n
CROAKING CISTICOLA..	P	P	P	0	n	0	n	0	p	p	n	n	0	n	p
LAZY CISTICOLA..	P	P	P	p	n	n	0	p	p	0	n	n	p	n	p
NEDDICKY..	P	P	P	p	n	0	n	p	p	p	n	n	p	n	p
TAWNYFLANKD PRINIA..	P	p	n	n	n	p	N	n	n	p	p	0	n	n	p
SPOTTED PRINIA..	P	p	P	p	n	n	p	p	p	n	N	0	p	0	0
SPOTTED FLYCATCHER..	P	p	N	N	0	p	n	n	n	0	p	0	n	0	0
DUSKY FLYCATCHER..	P	p	p	p	n	0	p	p	p	n	n	n	p	0	p
BLUEGRY FLYCATCHER..	P	p	n	n	n	0	p	p	p	n	p	0	p	p	p
FANTAIL FLYCATCHER..	P	p	N	n	p	0	n	N	n	n	P	p	n	p	0
BLACK FLYCATCHER..	P	p	N	n	p	p	n	n	n	0	p	p	n	0	0
PALLID FLYCATCHER..	P	p	N	n	p	0	n	n	n	0	P	p	n	0	0
FISCAL FLYCATCHER..	P	p	N	N	0	0	n	N	n	p	P	0	n	n	0
CAPE BATIS..	P	p	p	p	n	n	p	p	p	n	n	n	p	0	p
CHINSPOT BATIS..	P	p	N	N	p	p	n	N	n	p	P	p	n	0	n
BLUEMTL FLYCATCHER..	P	P	0	p	0	n	0	0	p	n	0	0	P	0	p
PARADSE FLYCATCHER..	P	0	0	0	0	p	n	0	0	n	0	0	0	0	p
AFR PIED WAGTAIL..	p	p	n	n	p	p	0	n	n	0	p	p	n	0	p
LONGTAILED WAGTAIL..	P	P	p	p	0	0	p	p	p	n	n	n	p	p	P
CAPE WAGTAIL..	P	p	p	p	n	0	n	p	p	p	n	n	n	n	n
RICHARD'S PIPIT..	P	p	n	n	0	0	n	n	n	p	0	p	n	n	n
LONGBILLED PIPIT..	P	p	P	p	n	0	p	p	p	0	n	0	p	0	0
PLAINBACKED PIPIT..	P	P	P	p	n	0	p	p	p	n	N	0	p	0	p
STRIPED PIPIT..	P	p	p	p	n	0	0	p	p	p	n	n	p	n	p
BUSHVELD PIPIT..	P	p	N	n	0	0	n	N	n	0	p	0	n	0	0
ORNGTHRTD LONGCLAW..	P	p	P	p	n	n	p	p	p	0	N	0	p	0	0
YLLWTHRTD LONGCLAW..	P	p	n	0	0	p	n	n	p	p	n	n	n	n	n
LESSER GREY SHRIKE..	P	P	N	N	p	n	0	n	N	p	p	p	n	0	0
FISCAL SHRIKE..	P	P	p	p	n	p	n	p	p	p	n	n	p	n	p
REDBACKED SHRIKE..	P	P	N	N	p	0	n	N	N	p	P	p	n	0	0
LONGTAILED SHRIKE..	P	P	N	n	p	n	n	0	n	p	p	p	n	p	0
SOUTHERN BOUBOU..	p	p	n	n	n	0	n	n	0	p	p	n	0	n	p
PUFFBACK..	P	p	N	n	0	0	n	n	n	n	p	p	0	0	p
BRUBRU..	P	P	N	N	p	0	n	n	n	0	P	p	n	p	n
SOUTHERN TCHAGRA..	P	P	P	P	0	n	0	0	p	0	n	0	p	0	0
THREESTRKD TCHAGRA..	P	p	N	N	p	0	n	N	n	p	P	p	n	0	0
BLCKCROWND TCHAGRA..	P	p	N	n	0	0	N	n	n	p	p	0	n	n	p
BOKMAKIERIE..	P	p	P	p	n	0	p	p	p	p	N	n	0	n	n
GRGOUS BUSH SHRIKE..	P	p	n	n	0	0	n	n	n	0	p	p	0	n	p
ORNGBR BUSH SHRIKE..	P	p	N	n	0	p	n	N	n	0	p	p	n	0	p
OLIVE BUSH SHRIKE..	p	p	p	p	0	n	p	p	p	n	0	n	P	0	p
GREYHD BUSH SHRIKE..	P	p	N	n	p	p	n	n	n	p	p	p	n	p	0
WHITE HELMETSHRIKE..	P	p	N	N	p	0	n	n	n	0	P	p	n	p	0
REDBL HELMETSHRIKE..	p	p	n	n	p	p	0	0	n	n	P	p	0	p	p
WATTLED STARLING..	P	P	n	N	0	0	0	n	n	p	p	p	n	0	n
PLUMCOLRD STARLING..	P	p	N	n	0	p	n	n	n	0	p	p	n	0	p
BURCHELL STARLING..	P	P	N	n	p	n	0	0	n	p	p	p	n	p	0
GLOSSY STARLING..	P	p	N	N	p	p	n	n	n	p	p	p	n	n	0
BLCKBELLD STARLING..	P	P	n	0	0	n	0	n	0	0	P	0	p	0	p
REDWINGED STARLING..	P	P	P	P	n	p	p	p	P	n	N	n	p	0	p
REDBILLED OXPECKER..	p	p	n	n	p	0	0	n	n	n	p	p	n	P	0
MALACHITE SUNBIRD..	P	p	P	p	n	0	P	p	p	n	n	0	p	p	p
MARICO SUNBIRD..	P	P	N	N	p	n	n	0	n	p	P	p	n	0	n
LSR DBLCLR SUNBIRD..	p	P	p	P	0	n	p	p	p	n	n	0	p	p	p
GTR DBLCLR SUNBIRD..	P	P	P	p	n	0	p	p	p	0	N	n	p	0	p
WHITEBELLD SUNBIRD..	P	p	N	n	0	p	n	n	n	0	P	p	n	0	p
GREY SUNBIRD..	P	P	n	0	0	n	0	0	p	0	P	0	0	0	n
OLIVE SUNBIRD..	P	p	P	p	n	0	p	p	p	n	n	n	p	0	p
SCRLTCHSTD SUNBIRD..	P	p	N	n	p	0	n	N	n	n	p	p	n	0	0
BLACK SUNBIRD..	P	P	P	p	n	0	0	p	p	0	N	n	p	n	p

COLLARED SUNBIRD..	P	p	n	p	0	n	0	0	p	n	p	0	p	0	p
CAPE WHITE-EYE..	P	P	P	p	n	0	0	p	p	n	n	n	p	n	p
HOUSE SPARROW..	P	p	n	n	p	0	n	n	n	p	p	p	n	n	n
GREYHEADED SPARROW..	P	p	n	N	0	p	n	n	n	p	p	0	n	n	n
YELLWTHRTD SPARROW..	P	P	n	N	0	p	n	n	n	p	p	p	n	p	0
THICKBILLED WEAVER..	P	p	n	n	0	p	0	n	n	n	p	p	0	0	p
FOREST WEAVER..	P	P	n	n	0	n	0	0	p	0	P	0	p	0	p
SPECTACLED WEAVER..	P	p	N	n	0	p	n	n	n	p	p	0	n	n	p
SPOTTEDBCKD WEAVER..	P	p	N	n	p	p	n	n	n	0	p	p	n	0	0
CAPE WEAVER..	P	p	P	p	n	0	p	p	p	p	N	0	0	0	n
MASKED WEAVER..	P	P	N	N	p	0	n	n	N	p	p	p	n	0	0
LSSR MASKED WEAVER..	P	P	N	N	p	0	0	n	n	0	p	p	n	0	0
GOLDEN WEAVER..	P	P	P	p	n	0	0	p	p	n	n	n	p	0	p
REDHEADED WEAVER..	P	0	N	n	0	0	0	0	n	n	p	0	n	p	0
REDBILLED QUELEA..	P	P	N	N	p	0	0	n	N	p	p	p	n	0	0
RED BISHOP..	P	P	n	n	p	0	n	n	n	p	0	p	n	n	n
YELLOWRUMPED WIDOW..	P	p	P	p	n	0	p	p	p	n	n	0	p	p	p
REDSHOULDERD WIDOW..	p	p	p	p	0	0	n	0	p	0	n	p	0	n	n
WHITEWINGED WIDOW..	P	p	N	N	p	0	n	n	n	p	P	p	n	n	0
REDCOLLARED WIDOW..	P	P	P	p	n	0	0	p	P	0	N	0	p	0	p
LONGTAILED WIDOW..	P	p	P	p	0	n	p	p	p	n	n	0	p	p	p
MELBA FINCH..	P	P	N	N	p	0	n	0	N	p	P	p	n	0	n
GREEN TWINSPOT..	P	p	p	p	0	n	p	P	p	n	n	0	p	p	p
PINKTHRTD TWINSPOT..	P	P	n	n	0	n	n	n	n	0	P	0	p	0	p
BLUEBLLD FIREFINCH..	P	P	P	p	n	0	0	p	p	0	n	n	p	n	p
JAMESON FIREFINCH..	P	p	N	n	p	0	0	N	n	0	P	p	n	p	p
REDBILLD FIREFINCH..	P	p	N	N	p	p	n	N	n	p	p	p	n	0	0
BLUE WAXBILL..	P	p	N	N	p	p	n	n	n	p	p	p	n	n	n
COMMON WAXBILL..	p	p	p	0	0	0	0	0	0	0	n	p	0	0	0
SWEE WAXBILL..	P	P	P	P	n	0	p	p	P	n	n	n	p	0	p
QUAIL FINCH..	P	p	p	0	n	p	n	p	p	p	n	n	0	n	n
ORNGEBRSTD WAXBILL..	P	p	p	0	0	n	0	0	0	p	n	0	0	p	n
BRONZE MANNIKIN..	P	p	p	0	n	p	n	p	p	p	n	0	n	n	p
REDBACKED MANNIKIN..	P	p	0	p	n	n	p	p	p	N	0	0	p	0	p
PINTAILED WHYDAH..	P	p	0	n	0	0	n	n	0	p	0	0	n	n	n
PARADISE WHYDAH..	P	P	N	N	p	0	n	0	N	p	p	p	n	0	n
BLACK WIDOWFINCH..	P	p	0	0	0	0	N	0	0	0	0	0	0	n	p
YELLOWEYE CANARY..	P	p	n	n	0	0	N	n	n	p	p	p	n	n	0
CAPE CANARY..	P	p	P	p	n	n	p	p	p	0	N	n	p	0	0
FOREST CANARY..	p	P	p	p	0	n	p	p	p	N	n	0	P	p	p
BULLY CANARY..	P	0	n	n	0	0	n	n	0	p	p	0	0	n	0
STREAKYHDED CANARY..	P	P	P	p	n	0	n	p	p	0	n	n	p	n	p
GOLDNBRSTD BUNTING..	P	p	n	N	0	p	n	n	n	p	p	0	N	0	n
ROCK BUNTING..	P	P	p	n	n	p	n	0	0	p	n	n	n	0	0

TABLE 3

NUMBERS OF SPECIES DISTRIBUTIONS WITH WHICH EACH VARIABLE IS SIGNIFICANTLY ASSOCIATED

KEY
T: No. of distributions significantly associated.
p: No. of distributions significantly positively associated.
n: No. of distributions significantly negatively associated.
P: No. of distributions highly significantly positively associated.
N: No. of distributions highly significantly negatively associated.

VARIABLE	T	p	n	P	N
Vegetation type	331	331	0	272	0
Geology	324	324	0	96	0
Altitude	315	108	207	58	97
Rainfall	295	94	201	17	48
Dams	225	147	78	14	0
Rivers	164	108	56	1	0
Cards	214	76	138	1	7
Plantations	250	84	166	1	19
Streams	281	102	179	5	11
Latitude	194	109	85	4	4
Longitude	292	190	102	52	28
Agriculture	228	168	60	5	0
Forests	250	84	166	7	2
Nature reserves	149	83	66	2	0
Altitude range	206	118	88	4	0

TABLE 4
GOODNESS OF FIT DATA
KEY
THE FIRST THREE COLUMNS INDICATE THE PERCENTAGE OF TOTAL VARIATION ACCOUNTED FOR BY THE COMBINED MODEL, ABIOTIC MODEL AND VEGETATION TYPES MODEL.

GOODNESS OF FIT MEASURES: (FOR THE COMBINED MODELS ONLY)
GOF1 = PREDICTION RESIDUALS/TOTAL DEVIANCE
GOF2 = PREDICTION RESIDUALS/RESIDUALS OF THE FITTED VALUES.

	COMBINED	ABIOTIC	VEGETATION	GOF1	GOF2
DABCHICK..	58	58	24	1.62	1.49
WHITBRST CORMORANT..	45	38	24	1.37	1.18
REED CORMORANT..	59	55	14	1.48	1.52
DARTER..	57	57	18	1.34	1.76
GREY HERON..	66	66	39	2.29	1.31
BLACKHEADED HERON..	45	45	23	1.35	1.35
PURPLE HERON..	64	64	20	1.69	1.66
GREAT WHITE EGRET..	76	74	46	3.05	1.37
LITTLE EGRET..	62	48	28	1.35	1.41
CATTLE EGRET..	53	51	20	1.54	1.39
SQUACCO HERON..	80	80	54	2.34	2.15
GREENBACKED HERON..	71	63	32	1.71	1.58
HAMERKOP..	41	41	19	1.50	1.13
WHITE STORK..	42	33	30	1.27	1.17
BLACK STORK..	67	65	26	2.35	1.21
WOOLLYNECK STORK..	58	57	55	1.64	1.42
MARABOU STORK..	91	91	38	3.59	3.17
YELLOWBILL STORK..	68	66	48	2.52	1.26
SACRED IBIS..	49	33	24	0.939	1.59
BALD IBIS..	83	82	43	3.30	1.72
HADEDA IBIS..	27	27	18	1.17	1.17
AFRICAN SPOONBILL..	54	50	22	1.51	1.32
WHITEFACED DUCK..	82	78	42	3.47	1.33
EGYPTIAN GOOSE..	62	62	29	1.29	2.08
YELLOWBILLED DUCK..	81	81	27	0.429	12.4
AFRICAN BLACK DUCK..	59	59	24	1.95	1.25
REDBILLED TEAL..	56	54	28	0.703	3.14
PYGMY GOOSE..	78	72	30	2.41	1.48
KNOBBILLED DUCK..	70	70	47	2.65	1.28
SPURWINGED GOOSE.	69	64	18	0.608	4.64
SECRETARYBIRD..	63	63	43	1.65	1.63
WHITEBACKD VULTURE..	86	82	65	3.63	1.98
WHITHEADED VULTURE..	76	73	48	2.49	1.48
YLWBLD/BLACK KITE..	39	35	30	1.26	1.23
BLACKSHOULDRD KITE..	41	39	20	1.36	1.20
CUCKOO HAWK..	25	25	0	1.22	1.10
TAWNY EAGLE..	43	43	43	1.61	1.09
WAHLBERG EAGLE..	68	68	66	2.91	1.07
LONGCRESTED EAGLE..	67	64	39	2.10	1.34
MARTIAL EAGLE..	58	52	40	1.97	1.22
CROWNED EAGLE..	70	70	21	1.76	1.91
BROWN SNAKE EAGLE..	43	38	26	1.42	1.13
BATELEUR..	70	70	38	0.948	3.55
AFRICAN FISH EAGLE..	77	72	43	2.36	1.54
STEPPE BUZZARD..	47	38	43	1.51	1.07
JACKAL BUZZARD..	77	77	66	2.77	1.59
LIZARD BUZZARD..	50	50	33	1.73	1.15
REDBRS SPARROWHAWK..	60	60	60	2.38	1.05
BLACK SPARROWHAWK..	5	5	0	1.02	1.03
AFRICAN GOSHAWK..	29	29	12	1.19	1.18
AFR MARSH HARRIER..	75	63	43	1.40	2.91
GYMNOGENE..	22	22	22	1.20	1.06

OSPREY..	48	48	42	1.00	1.95
LANNER FALCON..	17	11	17	1.08	1.04
HOBBY FALCON..	15	15	6	1.10	1.06
E REDFOOTD KESTREL..	19	19	17	1.09	1.14
ROCK KESTREL..	60	48	38	1.46	1.33
COQUI FRANCOLIN..	66	66	29	1.92	1.55
CRESTED FRANCOLIN..	69	69	65	2.81	1.16
SHELLEY FRANCOLIN..	48	48	23	1.42	1.36
REDWING FRANCOLIN..	84	84	63	1.52	4.10
NATAL FRANCOLIN..	50	50	32	1.28	1.55
SWAINSON FRANCOLIN..	53	53	48	1.48	1.45
COMMON QUAIL..	16	16	0	1.11	1.07
HELMETD GUINEAFOWL..	56	52	41	1.57	1.33
CRESTED GUINEAFOWL..	79	79	26	2.95	1.66
KRRCHN BUTTONQUAIL..	38	37	40	1.30	1.22
BLACK CRAKE..	67	64	37	2.00	1.41
MOORHEN..	85	67	31	1.55	1.98
REDKNOBBED COOT..	65	62	26	1.87	1.56
WHITEBELLD KORHAAN..	85	63	57	2.65	2.58
REDCRESTED KORHAAN..	66	63	38	2.13	1.29
BLACKBELLD KORHAAN..	23	23	12	1.10	1.17
AFRICAN JACANA..	86	81	47	3.07	1.74
KITTLITZ'S PLOVER..	83	84	49	2.76	2.28
THREEBANDED PLOVER..	59	57	42	1.74	1.36
CROWNED PLOVER..	70	70	50	2.63	1.28
LSR BLKWNGD PLOVER..	51	52	19	1.56	1.31
BLCKWNGD PLOVER..	72	72	47	1.26	2.82
BLACKSMITH PLOVER..	70	68	29	2.10	1.51
WATTLED PLOVER..	53	52	34	1.71	1.25
COMMON SANDPIPER..	55	52	31	1.71	1.30
WOOD SANDPIPER..	66	66	35	2.20	1.35
MARSH SANDPIPER..	70	70	47	2.23	1.51
GREENSHANK..	57	55	37	1.78	1.24
CURLEW SANDPIPER..	83	68	36	3.20	1.94
LITTLE STINT..	69	61	39	1.76	1.48
RUFF..	88	88	38	3.35	2.59
ETHIOPIAN SNIPE..	48	34	31	0.989	1.54
BLACKWINGED STILT..	92	80	42	6.26	2.14
SPOTTED DIKKOP..	22	19	17	1.10	1.12
WATER DIKKOP..	31	27	17	0.880	1.56
GREYHEADED GULL..	65	57	32	0.889	3.23
ROCK PIGEON..	39	35	32	1.37	1.20
RAMERON PIGEON..	78	78	51	2.36	2.00
REDEYED DOVE..	40	37	23	1.15	1.38
CAPE TURTLE DOVE..	78	78	47	2.87	1.59
LAUGHING DOVE..	70	66	64	2.42	1.24
NAMAQUA DOVE..	48	45	36	1.34	1.37
GREENSPOTTED DOVE..	80	73	68	2.36	1.57
TAMBOURINE DOVE..	51	46	41	1.61	1.15
GREEN PIGEON..	63	63	31	1.77	1.54
BROWNHEAD PARROT..	89	88	69	5.40	1.66
KNYSNA LOURIE..	86	86	30	2.71	2.70
PURPLECREST LOURIE..	66	63	54	1.80	1.50
GREY LOURIE..	82	81	49	2.54	2.08
AFRICAN CUCKOO..	42	42	40	1.56	1.11
REDCHESTED CUCKOO..	21	22	23	0.825	1.53
BLACK CUCKOO..	26	26	31	1.32	1.02
EMERALD CUCKOO..	49	39	35	1.38	1.42
KLAAS'S CUCKOO..	57	50	51	2.00	1.16
DIEDERIK CUCKOO..	34	29	34	1.25	1.12
BURCHELL'S COUCAL..	70	70	71	2.56	1.30
SCOPS OWL..	78	68	54	1.45	2.21
PEARLSPOTTED OWL..	89	89	63	2.23	4.11
FIERYNCK NIGHTJAR..	38	35	16	1.15	1.34

MOZAMBQ NIGHTJAR..	71	71	30	2.10	1.68
BLACK SWIFT..	50	41	42	1.46	1.15
WHITERUMPED SWIFT..	23	23	0	1.18	1.10
HORUS SWIFT..	49	46	51	1.51	1.24
LITTLE SWIFT..	44	41	19	1.22	1.39
PALM SWIFT..	47	45	13	1.16	1.57
SPECKLED MOUSEBIRD..	46	34	26	1.47	1.26
REDFACED MOUSEBIRD..	78	78	74	4.15	1.11
NARINA TROGON..	56	56	52	1.83	1.24
PIED KINGFISHER..	51	41	14	1.26	1.36
GIANT KINGFISHER..	34	34	0	1.36	1.11
HLFCLRD KINGFISHER..	54	54	43	1.56	1.40
MLCHITE KINGFISHER..	41	41	24	1.50	1.13
PYGMY KINGFISHER..	12	12	0	1.07	1.07
WOODLND KINGFISHER..	70	70	44	2.96	1.12
BRWNHD KINGFISHER..	52	49	41	1.51	1.30
STRIPED KINGFISHER..	75	67	57	2.19	1.38
EUROPEAN BEE-EATER..	73	73	70	3.20	1.18
WHTFRNT BEE-EATER..	53	51	23	1.07	2.01
LITTLE BEE-EATER..	58	51	26	1.60	1.28
EUROPEAN ROLLER..	58	58	56	2.11	1.14
LILACBRSTED ROLLER..	77	77	66	3.34	1.33
HOOPOE..	48	43	48	1.45	1.22
REDBLLD WOODHOOPOE..	59	59	47	2.16	1.13
SMTRBLD WOODHOOPOE..	72	71	65	2.46	1.47
TRUMPETER HORNBILL..	71	65	56	2.01	1.45
GREY HORNBILL..	74	70	58	2.84	1.17
REDBILLED HORNBILL..	78	78	45	1.53	2.98
YELLOWBLD HORNBILL..	84	81	60	3.69	1.45
CROWNED HORNBILL..	56	56	52	2.10	1.10
BLACKCOLLRD BARBET..	61	61	42	1.90	1.37
PIED BARBET..	76	74	44	2.49	1.57
RDFRT TNKER BARBET..	74	72	50	2.55	1.40
YLWFT TNKER BARBET..	90	90	47	1.92	5.62
GLDRP TNKER BARBET..	79	73	42	1.98	1.88
CRESTED BARBET..	61	53	38	1.59	1.34
GREATER HONEYGUIDE..	30	30	13	1.26	1.13
SCYTHRT HONEYGUIDE..	45	38	35	1.16	1.41
LESSER HONEYGUIDE..	40	32	31	1.16	1.26
SHRPBLD HONEYGUIDE..	38	38	34	1.39	1.16
GROUND WOODPECKER..	73	73	24	2.74	1.38
BENNETT WOODPECKER..	63	63	38	2.28	1.21
GLDNTLD WOODPECKER..	66	66	50	2.23	1.34
CARDINL WOODPECKER..	65	65	54	2.54	1.12
BEARDED WOODPECKER..	73	73	52	2.66	1.39
OLIVE WOODPECKER..	77	77	45	2.11	2.09
REDTHROATD WRYNECK..	41	41	29	1.44	1.17
RUFOUSNAPED LARK..	67	66	43	2.67	1.12
FLAPPET LARK..	69	69	65	2.62	1.26
SABOTA LARK..	82	79	54	3.11	1.58
REDCAPPED LARK..	70	67	51	1.33	2.30
EUROPEAN SWALLOW..	43	43	39	1.61	1.10
WHITETHRTD SWALLOW..	72	65	57	1.54	2.35
BLUE SWALLOW..	89	88	71	1.18	8.10
WIRETAILED SWALLOW..	68	67	31	1.98	1.57
REDBREASTD SWALLOW..	78	70	73	2.35	1.41
GRTR STRPD SWALLOW..	79	74	73	3.23	1.21
LSR STRIPD SWALLOW..	65	57	52	2.23	1.05
ROCK MARTIN..	61	58	35	1.11	2.32
HOUSE MARTIN..	16	16	4	1.09	1.09
GREYRUMPED SWALLOW..	73	66	45	1.94	1.53
BROWNTHRTED MARTIN..	65	60	36	1.73	1.66
BANDED MARTIN..	84	76	72	2.18	1.97

BLACK CUCKOOSHRIKE..	33	31	29	1.35	1.07
FORKTAILED DRONGO..	62	60	59	2.04	1.23
SQUARETAILD DRONGO..	95	95	56	0.822	26.1
BLACKHEADED ORIOLE..	37	28	28	1.08	1.28
BLACK CROW..	69	69	59	1.21	2.69
PIED CROW..	61	58	44	1.57	1.54
WHITENECKED RAVEN..	76	73	65	1.95	2.14
SOUTHERN BLACK TIT..	45	40	33	1.21	1.37
GREY PENDULINE TIT..	76	76	62	3.34	1.27
ARROWMARKD BABBLER..	80	78	72	3.11	1.46
BLACKEYED BULBUL..	55	55	17	1.84	1.22
TERRESTRIAL BULBUL..	62	59	51	1.91	1.30
SOMBRE BULBUL..	58	54	37	1.26	1.76
YELLOWSPTD NICATOR..	62	59	56	1.15	2.11
KURRICHANE THRUSH..	40	29	35	1.11	1.27
OLIVE THRUSH..	73	66	58	2.81	1.33
GRNDSCRAPER THRUSH..	55	44	42	1.54	1.16
CAPE ROCK THRUSH..	62	62	54	1.96	1.34
MOUNTAIN CHAT..	88	84	56	1.15	7.40
BUFFSTREAKED CHAT..	80	80	63	2.78	1.81
FAMILIAR CHAT..	57	57	39	1.41	1.67
MOCKING CHAT..	57	47	54	1.59	1.20
STONECHAT..	66	60	52	2.10	1.21
CHORISTER ROBIN..	71	65	59	2.57	1.11
HEUGLIN'S ROBIN..	80	74	67	2.12	1.85
NATAL ROBIN..	47	43	37	1.34	1.31
CAPE ROBIN..	75	74	69	2.96	1.32
WHITETHROATD ROBIN..	69	69	55	2.52	1.28
WHITEBROWED ROBIN..	78	76	71	3.13	1.34
AFR MARSH WARBLER..	54	54	34	1.45	1.51
ERPN MARSH WARBLER..	52	52	47	1.86	1.12
CAPE REED WARBLER..	45	43	18	1.34	1.31
YELLOW WARBLER..	20	20	27	1.19	1.05
AFR SEDGE WARBLER..	36	31	21	1.21	1.29
BROADTAILD WARBLER..	45	33	35	1.47	1.24
WILLOW WARBLER..	31	20	34	1.34	1.08
YELLWTHRTD WARBLER..	56	56	40	2.03	1.12
BARTHROATED APALIS..	55	50	43	1.55	1.29
YELLOWBRSTD APALIS..	82	78	68	2.16	2.11
RUDD'S APALIS..	79	79	52	3.74	1.29
LONGBILLED CROMBEC..	87	87	80	6.06	1.27
YLLWBLLD EREMOMELA..	52	52	43	1.93	1.08
BLEATING WARBLER..	60	60	46	1.87	1.34
STRLG BRRD WARBLER..	68	63	43	2.00	1.36
GRASSBIRD..	79	72	64	3.16	1.54
FANTAILD CISTICOLA..	48	48	35	1.41	1.36
DESERT CISTICOLA..	63	56	55	1.87	1.45
AYRES' CISTICOLA..	78	75	71	2.33	1.75
WAILING CISTICOLA..	85	83	70	4.80	1.42
RATTLING CISTICOLA..	87	87	80	6.12	1.30
REDFACED CISTICOLA..	55	48	39	1.48	1.31
LEVAILNT CISTICOLA..	86	83	77	4.02	1.47
CROAKING CISTICOLA..	45	41	35	1.37	1.34
LAZY CISTICOLA..	74	72	64	2.49	1.59
NEDDICKY..	72	69	59	2.96	1.20
TAWNYFLANKD PRINIA..	71	68	49	2.63	1.20
SPOTTED PRINIA..	86	85	66	5.12	1.31
SPOTTED FLYCATCHER..	24	24	24	1.22	1.07
DUSKY FLYCATCHER..	57	57	34	0.962	2.42
BLUEGRY FLYCATCHER..	56	56	42	1.63	1.40
FANTAIL FLYCATCHER..	56	56	52	2.06	1.11
BLACK FLYCATCHER..	56	53	53	1.77	1.22
PALLID FLYCATCHER..	70	70	65	2.76	1.21
FISCAL FLYCATCHER..	40	40	33	1.55	1.08

CAPE BATIS..	75	64	50	2.76	1.50
CHINSPOT BATIS..	85	84	68	4.95	1.39
BLUEMTL FLYCATCHER..	55	54	32	1.38	1.61
PARADSE FLYCATCHER..	18	18	25	1.06	1.14
AFR PIED WAGTAIL..	44	37	17	1.37	1.16
LONGTAILED WAGTAIL..	54	50	40	1.64	1.21
CAPE WAGTAIL..	69	64	58	1.90	1.49
RICHARD'S PIPIT..	61	54	48	1.80	1.22
LONGBILLED PIPIT..	73	70	65	2.51	1.48
PLAINBACKED PIPIT..	73	73	58	2.70	1.39
STRIPED PIPIT..	61	61	45	1.48	1.74
BUSHVELD PIPIT..	46	46	35	1.61	1.15
ORNGTHRTD LONGCLAW..	79	75	60	2.13	2.30
YLLWTHRTD LONGCLAW..	64	62	41	1.81	1.53
LESSER GREY SHRIKE..	43	43	38	1.43	1.24
FISCAL SHRIKE..	75	73	56	2.48	1.51
REDBACKED SHRIKE..	74	74	74	3.56	1.11
LONGTAILED SHRIKE..	75	72	60	1.31	2.80
SOUTHERN BOUBOU..	49	45	21	1.20	1.53
PUFFBACK..	57	56	44	1.71	1.33
BRUBRU..	81	81	64	3.93	1.34
SOUTHERN TCHAGRA..	37	37	21	1.16	1.38
THREESTRKD TCHAGRA..	76	76	61	3.81	1.12
BLCKCROWND TCHAGRA..	64	61	52	2.29	1.14
BOKMAKIERIE..	68	63	49	1.58	2.00
GRGOUS BUSH SHRIKE..	77	69	59	1.85	1.78
ORNGBR BUSH SHRIKE..	61	61	47	2.24	1.15
OLIVE BUSH SHRIKE..	54	51	24	1.60	1.36
GREYHD BUSH SHRIKE..	69	65	52	2.39	1.39
WHITE HELMETSHRIKE..	64	60	57	2.39	1.16
REDBL HELMETSHRIKE..	84	84	32	3.48	1.87
WATTLED STARLING..	54	47	36	1.53	1.25
PLUMCOLRD STARLING..	59	59	50	2.22	1.10
BURCHELL STARLING..	90	90	68	5.72	1.79
GLOSSY STARLING..	80	77	70	3.51	1.28
BLCKBELLD STARLING..	74	74	71	2.97	1.29
REDWINGED STARLING..	67	67	57	2.37	1.29
REDBILLED OXPECKER..	80	80	29	1.15	4.50
MALACHITE SUNBIRD..	91	91	79	3.49	3.48
MARICO SUNBIRD..	78	78	59	3.31	1.39
LSR DBLCLR SUNBIRD..	77	77	37	2.85	1.57
GTR DBLCLR SUNBIRD..	63	63	58	1.46	1.87
WHITEBELLD SUNBIRD..	81	78	73	3.40	1.39
GREY SUNBIRD..	90	90	81	1.40	7.50
OLIVE SUNBIRD..	79	69	64	2.02	1.64
SCRLTCHSTD SUNBIRD..	79	78	68	3.86	1.26
BLACK SUNBIRD..	76	75	70	3.03	1.32
COLLARED SUNBIRD..	68	68	54	2.18	1.44
CAPE WHITE-EYE..	75	72	59	2.28	1.60
HOUSE SPARROW..	33	33	25	1.25	1.19
GREYHEADED SPARROW..	65	65	49	2.37	1.23
YELLWTHRTD SPARROW..	57	57	40	1.92	1.22
THICKBILLED WEAVER..	37	32	26	1.26	1.16
FOREST WEAVER..	98	98	79	20.2	2.50
SPECTACLED WEAVER..	72	65	55	1.94	1.50
SPOTTEDBCKD WEAVER..	50	45	43	1.57	1.17
CAPE WEAVER..	90	86	75	6.42	1.66
MASKED WEAVER..	57	57	45	2.00	1.16
LSSR MASKED WEAVER..	42	42	37	1.38	1.25
GOLDEN WEAVER..	57	52	43	1.75	1.20
REDHEADED WEAVER..	36	36	20	1.41	1.12
REDBILLED QUELEA..	55	55	59	2.10	1.07
RED BISHOP..	49	49	43	1.62	1.22
YELLOWRUMPED WIDOW..	87	87	63	1.72	4.68

REDSHOULDERD WIDOW..	57	50	23	1.37	1.46
WHITEWINGED WIDOW..	71	68	62	2.80	1.14
REDCOLLARED WIDOW..	41	38	44	1.47	1.15
LONGTAILED WIDOW..	85	85	60	1.78	3.77
MELBA FINCH..	71	71	59	2.76	1.26
GREEN TWINSPOT..	81	81	43	1.29	4.25
PINKTHRTD TWINSPOT..	72	69	60	2.54	1.42
BLUEBLLD FIREFINCH..	62	58	51	1.77	1.34
JAMESON FIREFINCH..	65	63	35	2.28	1.20
REDBILLD FIREFINCH..	65	65	56	2.19	1.31
BLUE WAXBILL..	82	80	65	3.91	1.30
COMMON WAXBILL..	30	25	14	1.26	1.13
SWEE WAXBILL..	72	66	54	2.28	1.31
QUAIL FINCH..	56	53	40	1.36	1.68
ORNGEBRSTD WAXBILL..	47	44	26	1.32	1.43
BRONZE MANNIKIN..	62	58	41	1.66	1.58
REDBACKED MANNIKIN..	87	87	52	4.24	1.96
PINTAILED WHYDAH..	41	40	28	1.40	1.18
PARADISE WHYDAH..	66	66	52	2.39	1.24
BLACK WIDOWFINCH..	20	20	15	1.17	1.06
YELLOWEYE CANARY..	68	68	58	2.31	1.38
CAPE CANARY..	90	90	85	8.34	1.22
FOREST CANARY..	80	80	36	2.81	1.83
BULLY CANARY..	32	20	30	1.32	1.12
STREAKYHDED CANARY..	70	66	51	2.42	1.40
GOLDNBRSTD BUNTING..	50	51	47	1.71	1.17
ROCK BUNTING..	35	35	22	1.29	1.19

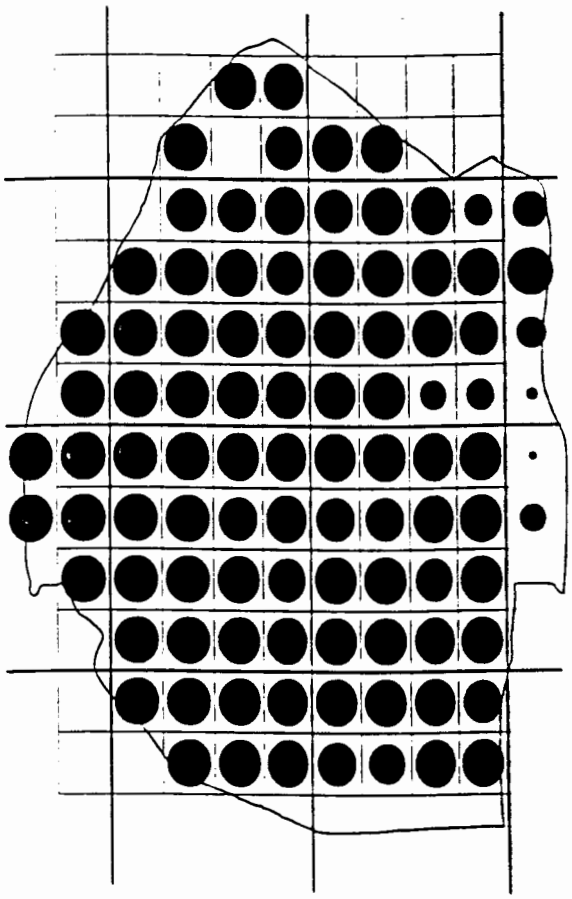
SUMMARY STATISTICS:	NON PASSERINES			PASSERINES AND NEAR PASSERINES		
PERCENTAGE OF VARIATION ACCOUNTED FOR BY:	MEAN	SD*	RANGE	MEAN	SD	RANGE
COMBINED MODEL :	58.7	19.6	5-92	62.6	17.5	12-98
ABIOTIC MODEL :	55.6	19.2	5-91	60.0	18.1	12-98
VEGETATION :	33.5	14.7	0-66	47.0	17.2	0-85
GOODNESS OF FIT STATISTICS						
GOF1 :	1.85	0.86	0.42-6.26	2.23	1.57	0.82-20.20
GOF2 :	1.73	1.31	1.03-12.46	1.68	1.82	1.02-26.14

* SD=STANDARD DEVIATION

FIG 1. OBSERVED AND PREDICTED DISTRIBUTIONS

1a. CAPE TURTLE DOVE (Goodness of fit stat.: gf1=2.9)

OBSERVED DISTRIBUTION



PREDICTED DISTRIBUTION

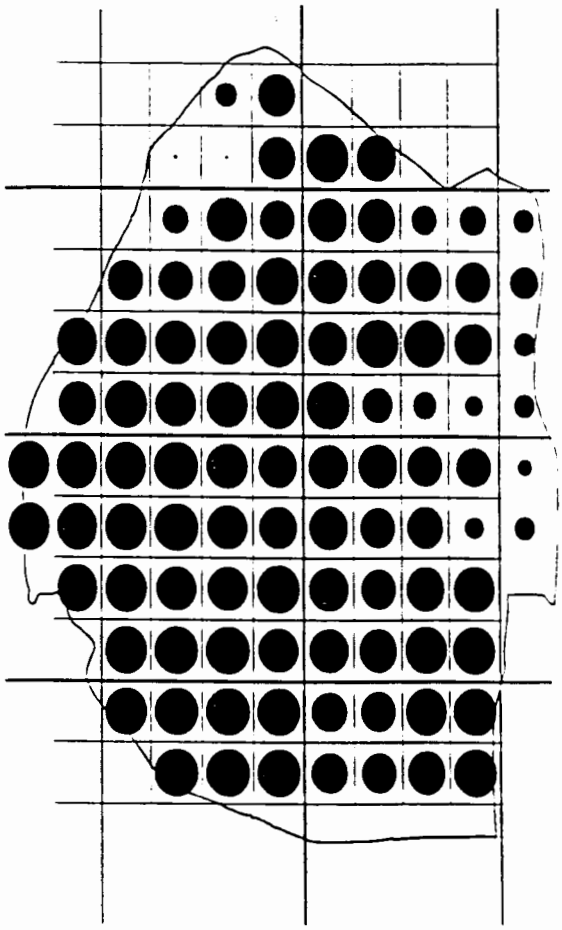
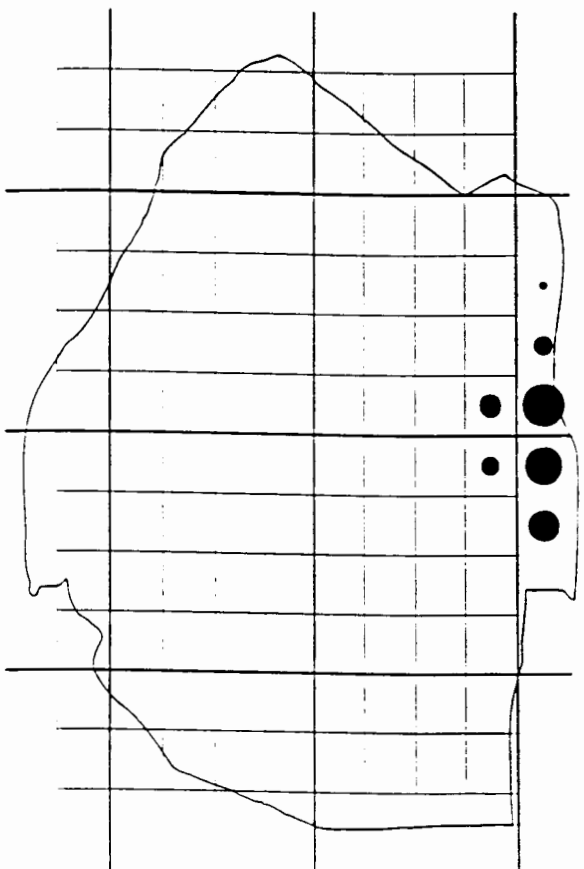


FIG 1b. FOREST WEAVER (Goodness of fit stat.: gf1=20.2)

OBSERVED DISTRIBUTION



PREDICTED DISTRIBUTION

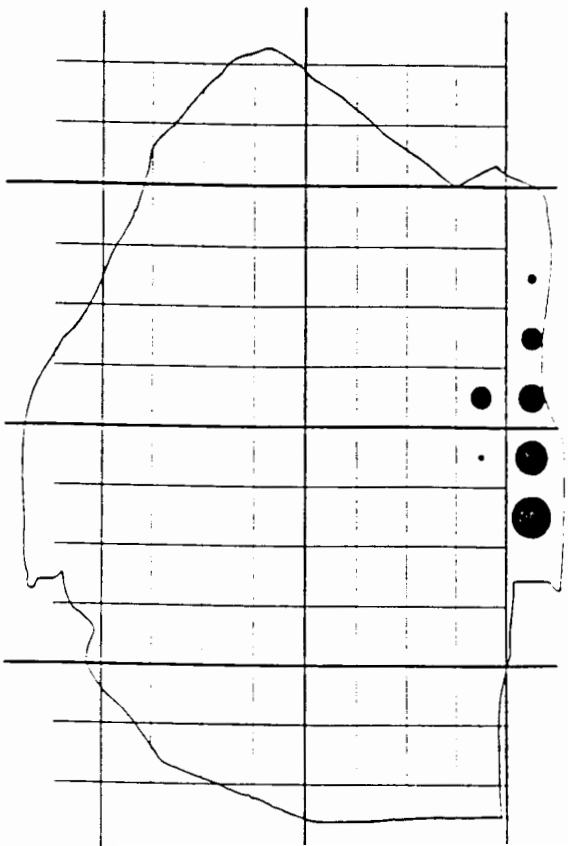
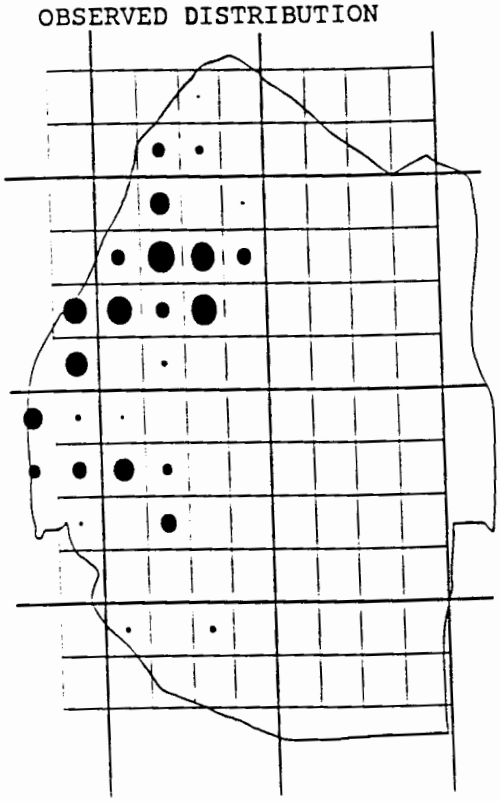


FIG 1c. WAILING CISTICOLA (Goodness of fit stat: gf1=4.8)

OBSERVED DISTRIBUTION



PREDICTED DISTRIBUTION

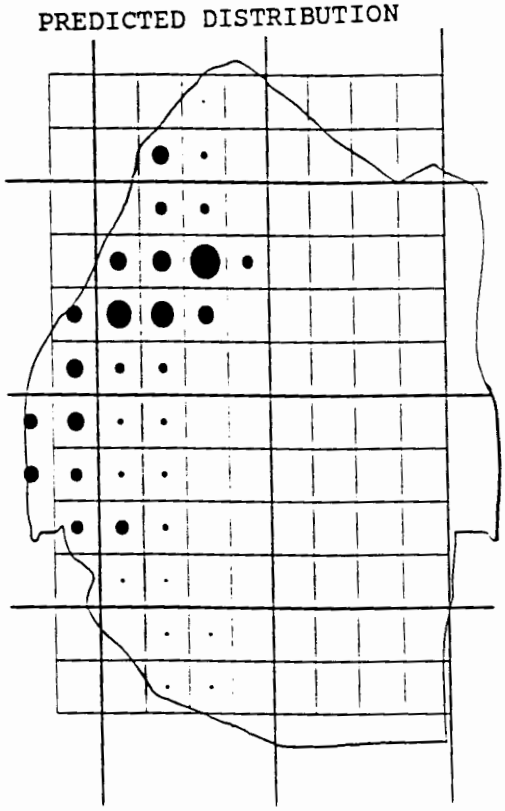
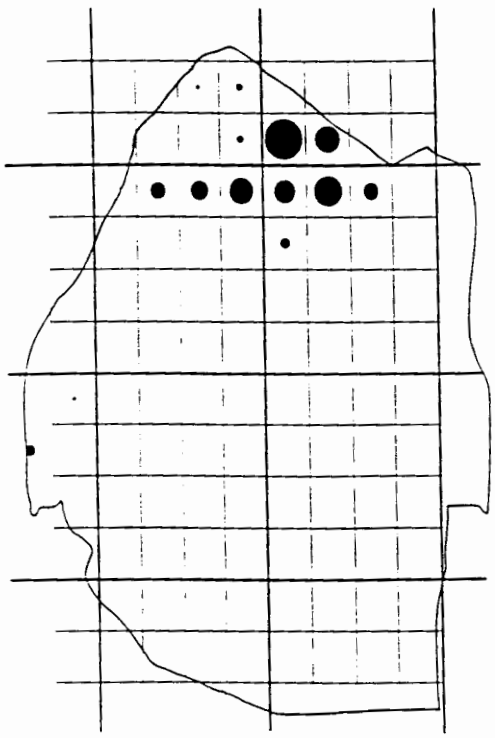
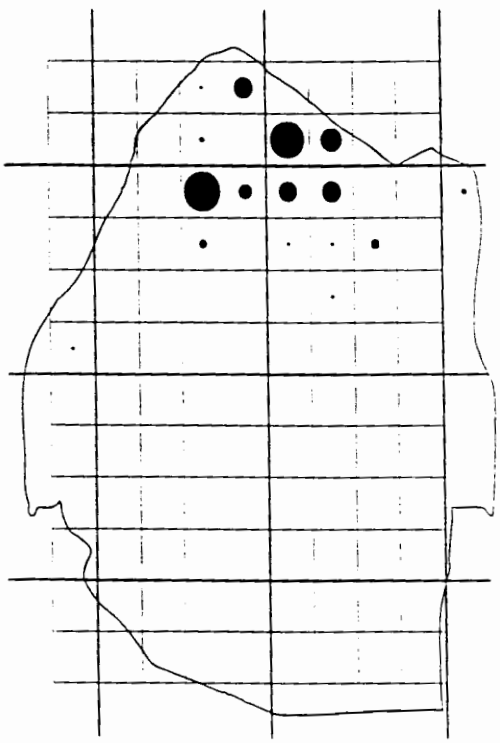


FIG 1d. YELLOWFRONTED TINKER BARBET
(Goodness of fit stat: gf1=1.02)

OBSERVED DISTRIBUTION



PREDICTED DISTRIBUTION



This predicted distribution does not represent the best fitting model derived for this species (Table 5) but was selected to illustrate the fit of a model for which gf1=1.

CHAPTER 3

THE AVIFAUNAL REGIONS OF SWAZILAND

SUMMARY

Biplot and cluster analysis techniques were used to investigate the geographical distribution of bird species in Swaziland. A principal components biplot was used to investigate the characteristics of a data matrix representing the reporting rates of 247 bird species at 98 localities (eighth degree grid squares) in Swaziland (Appendix 2). The ability of the biplot to reflect the known features of the data was confirmed and a new insight into the composition of the avifauna of the Lubombo region was obtained. The biplot was used to assess to what extent the geographical distribution of bird species is related to classifications of the localities based on topography, altitude, vegetation types, primary productivity, ecological regions and climate. Cluster analysis techniques were used to partition Swaziland into regions which are distinctive with respect to the species composition of the avifauna (avifaunal regions). The biplot was used to validate the solutions provided by the cluster analysis. Clustering by average and complete linkage both produced plausible classifications representing avifaunal regions. The regions obtained by average linkage were preferred because they were more distinct from each other.

INTRODUCTION

Classification of the land surface area of Swaziland and of South Africa into regions by vegetation type has previously been carried out primarily as a guide to the agricultural potential of the different areas (Acocks 1975; I'ons 1967). Here cluster analysis on bird atlas data was used to partition the land surface area of Swaziland into avifaunal regions primarily to see how closely these would correspond to the vegetation type classifications and so throw further light on the nature of the relationship between bird distributions and vegetation types. Cluster analysis has previously been

used to partition Africa into avifaunal regions based on presence/absence data for bird species (Crowe & Crowe 1982). The method has also been used to partition parts of the southern African coastline based on counts of waders (Underhill 1979). In this study, the partition of the study area is based on reporting rates of terrestrial birds. The use of reporting rates allows a finer partition than that obtained by Crowe & Crowe (1982) and on a similar scale to that obtained by Underhill (1979).

Categorisations obtained by a cluster analysis should be subject to external verification whenever possible (Aldenderfer & Blashfield 1984). Here the principal components biplot is used to verify the avifaunal regions obtained by cluster analysis. In addition, the biplot was examined to see whether it revealed additional insights into the nature of the bird distribution patterns which would otherwise have remained hidden in the mass of the data.

Biplots have been widely used to investigate the properties of multi-dimensional data matrices by representing them in lower dimensional space (Greenacre & Underhill 1982). Here a biplot was used to investigate how the reporting rates of bird species in 98 localities (grid squares) relate to various geographical characteristics.

METHODS

A data matrix consisting of the reporting rates (Underhill et al. 1992) of 247 bird species in each of 98 one eighth degree grid squares was constructed. Water birds were excluded from the analysis because their geographical distributions are determined more by the presence of open water bodies than by the variables of interest here. Birds of prey were omitted because their observed geographical distributions are believed to show greater randomness than other species (Appendix 2). Two ubiquitous species, the Blackeyed Bulbul *Pycnonotus barbatus* and Yelloweyed

Canary *Serinus mozambicus,* were omitted because their reporting rates did not vary across the study area. All other bird species which had been reported at least 20 times in the atlas data were included (Appendix 2). A principal components biplot (Gabriel 1971; Greenacre & Underhill 1982) was used to represent the data matrix graphically.

Classifications of the grid squares by ecological regions, landface characteristics, primary productivity and climatic regions were extracted from GIS databases supplied by the Institute for Water Quality Studies, Department of Water Affairs & Forestry, Pretoria (ecoregions), GISlab, University of Pretoria (landface) and the Department of Agricultural Engineering, University of Natal (primary productivity and climatic zones) using the ARC/INFO software (Environmental Systems Research Institute). A classification by altitude was obtained by allocating grid squares to eight altitude classes (with intervals of 200m) according to the mean of the altitudes obtained from 1:50 000 maps (Government of Swaziland 1980) of forty randomly selected points within the grid square. A classification by topographic regions was obtained by allocating each grid square to the region in the map by Goudie & Price Williams (1979) which covered the greatest proportion of the square. Similarly, alternative classifications by vegetation type were obtained from the maps by Goudie & Price-Williams (1979) and Acocks (1975).

In order to confirm the visual impression of how closely the relative positions of the points in the biplot related to the respective classifications, the sum of squares of euclidean distances of each point within a category from the centroid of the category was calculated and the total over all categories of the sums of squares within categories was expressed as a percentage of the sum of squares of distances of all points from the origin of the biplot (Appendix 1). This percentage (sums of squares index) was used as an index of how well the relative positions of the points was explained by the respective classification (low values indicate good performance by the classification).

In order to justify the preference of principal components over the covariance (Greenacre &

Underhill 1982) and correspondence analysis (Greenacre 1984) biplots for this analysis, the sums of squares indices obtained for the altitude and vegetation type classifications using each of the biplot methods were compared.

Classification of the 98 grid squares into avifaunal regions was carried out using the BMDP (Dixon et al. 1990) program 1M for cluster analysis of variables with average linkage and using correlation coefficients as the similarity measure. Alternative classifications were obtained using complete linkage and by using the BMDP program 2M for cluster analysis of cases on the transposed matrix, with single and centroid linkage, using euclidean distances as the similarity measure. The criteria used to determine the level of clustering were that firstly the number of categories should be between seven and fifteen for the avifaunal regions to be comparable with the other classifications, secondly that grid squares within a category should not be widely separated geographically and thirdly that the number of categories should be as small as possible taking into account the above constraints. For each classification, the categories were identified on the biplot and the sums of squares index was calculated.

For each avifaunal region, the mean of reporting rates over the grid squares in the region was used to rank the bird species. The eleven species with the highest mean reporting rates were identified for each region. The reporting rates are regarded as an index of the relative population densities of the species (Chapter 1).

RESULTS

The quality of the display in two dimensions was 72.4% for principal components and covariance and 38.7% for the correspondence analysis biplots. This suggested that a two dimensional display was adequate to graphically represent the data matrix.

The visual impression from the biplot (Fig 1b-h) that altitude did better than the other classifications

based on environmental factors was confirmed by the sums of squares index (Table 1).

The sums of squares index for the vegetation types classification was 17 for the principal components biplot and 21 for both the correspondence analysis and covariance biplots. For the altitude classification, the indices were 14 for principal components and 18 for each of the other biplots. This confirmed that the principal components biplot was more suitable than the other two options for representing the grid squares.

The cluster analyses based on cases (program 2M) produced classifications which were regarded as unsuitable because the majority of clusters consisted of a single grid square. By contrast, cluster analysis of variables (1M) yielded no single square clusters. The level of clustering selected to define the avifaunal regions was that which produced nine categories in both cases. At the next level (producing eight categories) in both cases categories which are widely separated geographically would be joined (these categories are labelled A and B in Fig. 1i and 1j). The classifications produced by complete and average linkage both appeared to do better than the other available classifications in explaining the relative positions of the points in the biplot (Fig 1) in that there is little overlap between the categories. This is confirmed by the sums of squares indices (Table 1) which also suggests that the classification by complete linkage performs marginally better in this respect.

The classification by complete linkage produced categories containing a minimum of three grid squares and a maximum of 26. By average linkage, the corresponding minimum was two and maximum 39.

For the classifications produced by average and complete linkage, all of the regions differed from each other with respect to the most frequently observed species (Table 3). For complete linkage, 19 species appeared in the list of common birds for only one region and each pair of regions had at most 9 species in common. For average linkage, the corresponding figures are 23 species in

one region only and at most 7 species common to any pair of regions.

By comparison with average linkage, clustering by complete linkage produced categories which were more uniform in terms of the numbers of grid squares in each category. On the other hand, the clusters produced by average linkage appear to be more distinct from each other in terms of the most frequently observed species. On this basis, and in spite of the slight advantage of the complete linkage clustering with respect to the sums of squares criterion, the categories defined by average linking were adopted as defining the avifaunal regions of Swaziland (Fig. 1i).

DISCUSSION

The following essential features of the representation of the grid squares in the biplot are evident in Fig. 1b. The highveld and lowveld are at opposite poles of the biplot, indicating that these two regions are distinct from each other with respect to avifauna. This polarity of the biplot was emphasised by examination of the positions of points representing the bird species in the biplot. All species which occur predominantly in the lowveld lay above the horizontal axis and those which occur in the highveld lay below the axis. The horseshoe shape of the representation of the grid squares is due to some species being common to both highveld and lowveld. The middleveld is clearly transitional in nature between the highveld and lowveld. These findings are consistent with existing knowledge of the avifauna of the region (Appendix 2). The biplot shows that the Lubombo region is also transitional between the highveld and lowveld and appears to be a variation of the middleveld type rather than a distinct region. Although some bird species occur exclusively in the Lubombo region within Swaziland (Appendix 2), the biplot indicates that as far as relative densities of the more frequently observed species are concerned, this region is not significantly different from the middleveld.

Points in the biplot representing grid squares in the lowveld are more tightly clustered than those representing the middleveld and highveld (Fig 1b). The lowveld is in fact more homogeneous with respect to relief and vegetation than the other regions (Appendix 2) and the biplot indicates that the composition of its avifauna is correspondingly more homogeneous.

Comparison of classifications with respect to the sums of squares index is not straightforward because differences in the numbers of categories of the classifications have to be taken into account. The comparison of the vegetation type classifications of Acocks (1975) and Goudie & Price-Williams (1979) is therefore inconclusive (Table 1). However, if a classification has a lower sums of squares index and a lower or equal number of categories than another, it may be considered to have performed better in explaining the relative positions of the grid squares in the

biplot. Hence the classification by altitude appears to have performed better than vegetation types (Table 1). However, the biplot was developed as a graphical display method and can not be expected to provide a particularly accurate measure of strengths of association between variables. This result therefore indicates merely that the two classifications are close in this respect.

The biplot suggests that the four classifications obtained from the GIS (eco-regions, landface, primary productivity and climatic regions) have not performed as well as altitude (Table 1). Moreover, the landface classification which may be regarded as closely related to the classification by topographic regions, appears to have performed less well than that classification. This may indicate either that bird distribution patterns are not significantly associated with the factors represented by these classifications or that the data on which these classifications are based are not accurate on the eighth degree grid scale for the study area. On the one hand it is not surprising that primary productivity performs relatively poorly, as it is not expected to be particularly closely related to bird species distributions. On the other hand, climatic factors might be expected to determine bird distributions at least as much as altitude. It is conceivable that if the factors which contribute to the climatic regions classification were weighted differently, this classification might relate more closely to the bird distribution patterns.

The biplot could conceivably be used as a tool for correcting the GIS classifications if these were believed to be inaccurate. If for example it was considered desirable for the eco-regions classification to relate more closely to bird distributions, then the biplot indicates that the category H in particular combines grid squares which are very different with respect to avifauna (Fig 1e), and needs to be revised.

The cluster analysis confirms the relationship between the Lubombo region and the middleveld suggested by the biplot. Using both linkage methods, the next level of clustering would amalgamate the Lubombo region with a middleveld region.

The avifaunal region (by average linkage) labelled D (Fig 1i) is of particular interest because it is likely that anthropogenic intervention has given it a character different from the rest of the lowveld. A large proportion of the region falls within nature reserves and the effect of little or no culling of wild ungulates having been carried out in these reserves has been the occurrence of bush encroachment on a scale not experienced elsewhere in the region (Appendix 2). This constitutes the most apparent difference in habitat between this region and region C.

The avifaunal region (by average linkage) labelled I (Fig 1i) corresponds with the industrialised part of the country. However, the anthropogenic factor does not necessarily explain the distinctiveness of the avifauna of the region. This region is topographically the flattest part of the Middleveld (Government of Swaziland 1980) and this is more likely to explain the distinctiveness of the region because field observations in the region tended to be concentrated in the parts least affected by industrialisation.

The avifaunal regions (by average linkage) correspond closely with the major topographic regions as defined by Goudie & Price-Williams (1979). The regions F, G and H (Fig 1i) correspond with the highveld, C,D and E with the lowveld, B with the Lubombos and the rest with the middleveld. However, the avifaunal regions indicate that avifauna typical of the lowveld intrude further westwards along the Usutu and Ngwempisi river valleys than indicated by the boundaries of the topographic regions.

The avifaunal regions (by average linkage) also correspond largely with the vegetation types of Goudie & Price-Williams (1979) in the lowveld and highveld (Table 2a). However, the avifaunal regions suggest that the northern and southern sections of the Highland Sour Grassland vegetation type could be regarded as distinct regions. This is supported by the distribution maps for several species (Appendix 2). For example, two grassland species, the Whitebellied Korhaan *Eopodotis cafra* and Redcapped Lark *Calandrella cinerea* were observed more frequently in the south of this vegetation type than the north while several forest species such as the Cape Batis *Batis capensis*

were observed more often in the north than the south. This in turn reflects the fact that the southern part of this vegetation type is more arid in nature than the north and differs with respect to the structure of the vegetation while the species composition of the vegetation is similar. The vegetation types were determined by the species composition of the vegetation (l'ons 1967). There is no obvious correspondence between avifaunal regions and vegetation types in the middleveld. This might have been expected because it is a highly diverse region which is difficult to categorise (l'ons 1967; Appendix 2). The alternative classification by complete linkage corresponds to the vegetation types in largely the same way (Table 2b), and also divides the Highland Sour Grassland type.

Similar cluster analysis methods have been used to analyze distribution patterns of birds and other vertebrates on a continental and sub-continental scale (Crowe 1990; Crowe & Crowe 1982; Guillet & Crowe 1985). In those studies, the analyses were based on presence/absence data rather than reporting rates and multidimensional scaling was used to validate the classifications obtained by clustering in a similar manner to which the biplot was used in this study. The biplot may perform better than multidimensional scaling in these applications because of its greater simplicity. However, direct comparison of the two methods still needs to be done.

The basis for distinction between zones in the above studies was endemism. The same analysis could not be applied within Swaziland because no bird species is endemic to the country. However, if distributions outside of Swaziland are ignored, it has been shown that a number of species are specific to each of the major topographic regions (Appendix 2). On the other hand, the avifaunal regions derived here are not distinctive in terms of species occurring exclusively within them, with the exception of the Lubombo region. The White-eared Barbet *Stactolaema leucotis* and Livingstone's Lourie *Tauraco livingstonii* occur exclusively in the Lubombos. A further two species (Grey Sunbird *Nectarinia veroxii* and Forest Weaver *Ploceus bicolor*) are nearly exclusive to the Lubombos in that more than two thirds of the observations of these species were in the Lubombos. Two other species were nearly exclusive to a region (the Lesser Blackwinged

Plover *Vanellus lugubris* to region C and the Redcapped Lark to region H (Fig 1i)).

Although the avifaunal regions are not distinctive in terms of species exclusive to the regions, the use of reporting rates in this analysis has made it possible to distinguish between the regions on a more subtle basis. The avifaunal regions are indeed distinctive with respect to the species observed most frequently in each.

It is envisaged that a similar cluster analysis will be carried out on the bird atlas data for southern Africa (Harrison 1992) in order to verify that bird distribution patterns in the region correspond closely with vegetation zones (D. G. Allan, pers. comm.).

TABLE 1

COMPARISON OF CLASSIFICATIONS OF GRID SQUARES WITH RESPECT TO THE SUMS OF SQUARES INDEX

CLASSIFICATION	NO. OF CATEGORIES	SUMS OF SQUARES INDEX
TOPOGRAPHY	4	20
VEGETATION TYPES (Goudie & Price-Williams)	11	17
VEGETATION TYPES (Acocks)	7	20
ALTITUDE	8	14
ECO-REGIONS	8	34
LANDFACE	12	22
PRIMARY PRODUCTIVITY	6	42
CLIMATIC REGIONS	17	16
AVIFAUNAL REGIONS (complete linkage)	9	9
AVIFAUNAL REGIONS (average linkage)	9	10

TABLE 2a

CORRESPONDENCE BETWEEN AVIFAUNAL REGIONS AND VEGETATION TYPES

AVIFAUNAL REGION	VEGETATION TYPE
B	LUBOMBO TYPE
C	MOISTER SAVANNA & ACACIA SAVANNA
E	DRYER EASTERN SAVANNA
F	SOUR MOUNTAIN GRASSLAND
G	HIGHLAND SOUR GRASSLAND(NORTH)
H	HIGHLAND SOUR GRASSLAND(SOUTH)& UPLAND TALL GRASSVELD

TABLE 2b

CORRESPONDENCE BETWEEN REGIONS BY COMPLETE LINKAGE AND VEGETATION TYPES

REGION	VEGETATION TYPE
B	LUBOMBO TYPE
E	HIGHLAND SOUR GRASSLAND
F	HIGHLAND SOUR GRASSLAND
H	HIGHLAND SOUR GRASSLAND
G	SOUR MOUNTAIN GRASSLAND
I	MOISTER SAVANNA
J	ACACIA SAVANNA
K	DRYER EASTERN SAVANNA

TABLE 3a

COMMONEST BIRD SPECIES FOR AVIFAUNAL REGIONS
(CLUSTERING BY AVERAGE LINKAGE)
THE 13 SPECIES WITH THE HIGHEST REPORTING RATES FOR EACH REGION.

* INDICATES A SPECIES INCLUDED UNDER NO OTHER REGION.

REGION A

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.99
SOMBRE BULBUL	0.95
YELLOWEYED CANARY	0.93
BLACKCOLLARED BARBET	0.92
GREENSPOTTED DOVE	0.91
SOUTHERN BOUBOU	0.91
TAWNYFLANKED PRINIA	0.88
CAPE TURTLE DOVE	0.87
CAPE WHITE-EYE	0.85
FISCAL SHRIKE	0.85
BROWNHOOD KINGFISHER	0.85
BRONZE MANNIKIN	0.84
FORKTAILED DRONGO	0.83

REGION B

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.99
SOMBRE BULBUL	0.98
SOUTHERN BOUBOU	0.96
BLEATING WARBLER*	0.91
PUFFBACK	0.91
YELLOWEYED CANARY	0.89
YELLOWBREASTD APALIS*	0.89
PURPLECRESTED LOURIE*	0.88
GREENSPOTTED DOVE	0.88
CAPE WHITE-EYE	0.87
WHITEBROWED ROBIN	0.87
BLACKCROWNED TCHAGRA*	0.85
TERRESTRIAL BULBUL*	0.84

REGION C

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.98
RATTLING CISTICOLA	0.97
YELLOWEYED CANARY	0.95
GREENSPOTTED DOVE	0.95
FORKTAILED DRONGO	0.94
BLUE WAXBILL	0.94
SOMBRE BULBUL	0.93
WHITEBROWED ROBIN	0.93
CAPE TURTLE DOVE	0.90
WHITEBELLIED SUNBIRD	0.89
GLOSSY STARLING	0.89
SOUTHERN BOUBOU	0.88
TAWNYFLANKED PRINIA	0.87

REGION D

SPECIES	REPORTING RATE
WHITEBROWED ROBIN	0.91
BLACKEYED BULBUL	0.89
GREENSPOTTED DOVE	0.88
YELLOWEYED CANARY	0.87
BLACKHEADED ORIOLE*	0.87
CHINSPOT BATIS	0.87
RATTLING CISTICOLA	0.85
PUFFBACK	0.84
FORKTAILED DRONGO	0.83
CAPE TURTLE DOVE	0.82
BLUE WAXBILL	0.82
BLACK TIT*	0.81
BROWNHOOD KINGFISHER	0.79

REGION E

SPECIES	REPORTING RATE
RATTLING CISTICOLA	1.00
LONGBILLED CROMBEC*	1.00
BLUE WAXBILL	1.00
GLOSSY STARLING	1.00
WHITEBROWED ROBIN	1.00
YELLOWEYED CANARY	0.96
LONGTAILED SHRIKE*	0.96
CAPE TURTLE DOVE	0.96
YELLOWBLLED HORNBILL*	0.96
SABOTA LARK*	0.96
FORKTAILED DRONGO	0.96
CHINSPOT BATIS	0.96
BLACKEYED BULBUL	0.92

REGION F

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.99
CAPE WHITE-EYE	0.87
SOMBRE BULBUL	0.87
FISCAL SHRIKE	0.83
CAPE TURTLE DOVE	0.80
SPECKLED MOUSEBIRD	0.79
LAZY CISTICOLA	0.77
BLUEBILLED FIREFINCH	0.77
YELLOWEYED CANARY	0.75
STONECHAT	0.75
COMMON WAXBILL	0.68
REDEYED DOVE*	0.68
BLACKCOLLARED BARBET	0.68

TABLE 3a continued

REGION G

SPECIES	REPORTING RATE
CAPE TURTLE DOVE	0.92
LEVAILLANT CISTICOLA	0.90
BLACKEYED BULBUL	0.88
ORANGETHRTD LONGCLAW*	0.87
FORKTAILED DRONGO	0.85
LAZY CISTICOLA	0.77
QUAIL FINCH*	0.77
CAPE CANARY*	0.77
BUFFSTREAKED CHAT*	0.76
CAPE WHITE-EYE	0.73
SPOTTED PRINIA*	0.73
BLUEBILLED FIREFINCH	0.71
YELLOWEYED CANARY	0.70

REGION H

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.99
CAPE TURTLE DOVE	0.99
YELLOWEYED CANARY	0.96
FORKTAILED DRONGO	0.96
FISCAL SHRIKE	0.93
TAWNYFLANKED PRINIA	0.90
CAPE WHITE-EYE	0.86
CAPE WAGTAIL*	0.85
LEVAILLANT CISTICOLA	0.84
RUFOUSNAPED LARK*	0.83
BROWNHOOD KINGFISHER	0.83
NEDDICKY*	0.82
RICHARDS PIPIT*	0.81

REGION I

SPECIES	REPORTING RATE
FISCAL SHRIKE	0.97
BLACKEYED BULBUL	0.94
STONECHAT	0.88
YELLOWTHRTD LONGCLAW*	0.88
COMMON WAXBILL	0.82
CAPE TURTLE DOVE	0.81
TAWNYFLANKED PRINIA	0.79
WHITEBELLIED SUNBIRD	0.79
YELLOWEYED CANARY	0.76
SPECKLED MOUSEBIRD	0.76
BRONZE MANNIKIN	0.76
LEVAILLANT CISTICOLA	0.76
REDSHOULDERED WIDOW*	0.76

TABLE 3b

COMMONEST BIRD SPECIES FOR AVIFAUNAL REGIONS
(CLUSTERING BY COMPLETE LINKAGE)
THE 13 SPECIES WITH THE HIGHEST REPORTING RATES FOR EACH REGION ARE LISTED

* INDICATES A SPECIES INCLUDED UNDER NO OTHER REGION

REGION A

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.99
SOMBRE BULBUL	0.95
HEUGLIN'S ROBIN*	0.94
CAPE WHITE-EYE	0.94
GREENSPOTTED DOVE	0.92
BLEATING WARBLER	0.92
SOUTHERN BOUBOU	0.87
BLACKCOLLARED BARBET	0.87
PUFFBACK	0.87
SPECTACLED WEAVER*	0.86
YELLOWEYED CANARY	0.85
BLUEBILLED FIREFINCH	0.85
SQUARETAILED DRONGO*	0.84

REGION B

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.99
SOMBRE BULBUL	0.98
SOUTHERN BOUBOU	0.96
PUFFBACK	0.91
BLEATING WARBLER	0.91
YELLOWEYED CANARY	0.89
YELLOWBREASTED APALIS*	0.89
PURPLECRESTED LOURIE*	0.88
GREENSPOTTED DOVE	0.88
CAPE WHITE-EYE	0.87
WHITEBROWED ROBIN	0.87
BLACKCROWNED TCHAGRA*	0.85
TERRESTRIAL BULBUL*	0.84

REGION C

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.99
CAPE TURTLE DOVE	0.92
YELLOWEYED CANARY	0.91
FISCAL SHRIKE	0.89
SOMBRE BULBUL	0.88
BLACKCOLLARED BARBET	0.87
TAWNYFLANKED PRINIA	0.86
GREENSPOTTED DOVE	0.85
YELLOWTHRTED LONGCLAW*	0.84
BRONZE MANNIKIN*	0.83
FORKTAILED DRONGO	0.81
SOUTHERN BOUBOU	0.80
CAPE WHITE-EYE	0.80

REGION D

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.99
CAPE TURTLE DOVE	0.96
YELLOWEYED CANARY	0.94
FORKTAILED DRONGO	0.94
FISCAL SHRIKE	0.89
TAWNYFLANKED PRINIA	0.87
CAPE WHITE-EYE	0.86
NEDDICKY*	0.81
LEVAILLANT CISTICOLA	0.80
BROWNHOOD KINGFISHER	0.80
RUFOUSNAPED LARK*	0.79
CAPE WAGTAIL*	0.77
BLACKHEADED ORIOLE*	0.77

REGION E

SPECIES	REPORTING RATE
BLACKEYED BULBUL	1.00
SOMBRE BULBUL	0.97
CAPE WHITE-EYE	0.92
BLUEBILLED FIREFINCH	0.90
SPECKLED MOUSEBIRD*	0.88
YELLOWEYED CANARY	0.86
BLEATING WARBLER	0.84
LAZY CISTICOLA	0.83
SOUTHERN BOUBOU	0.83
TAWNYFLANKED PRINIA	0.80
FISCAL SHRIKE	0.79
STONECHAT	0.78
PUFFBACK	0.77

REGION F

SPECIES	REPORTING RATE
CAPE TURTLE DOVE	0.91
BLACKEYED BULBUL	0.89
LEVAILLANT CISTICOLA	0.80
STONECHAT	0.80
FORKTAILED DRONGO	0.79
ORANGETHRTED LONGCLAW*	0.77
FISCAL SHRIKE	0.76
CAPE WHITE-EYE	0.76
SPOTTED PRINIA*	0.76
REDWINGED STARLING*	0.75
LAZY CISTICOLA	0.75
BUFFSTREAKED CHAT*	0.74
CAPE CANARY*	0.71

TABLE 3b continued

REGION G

SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.98
RATTLING CISTICOLA	0.96
GREENSPOTTED DOVE	0.95
YELLOWEYED CANARY	0.94
SOMBRE BULBUL	0.94
FORKTAILED DRONGO	0.93
WHITEBROWED ROBIN	0.93
BLUE WAXBILL	0.92
BROWNHOOD KINGFISHER	0.89
WHITEBELLIED SUNBIRD	0.88
BLACKCOLLARED BARBET	0.88
TAWNYFLANKED PRINIA	0.88
CAPE TURTLE DOVE	0.87

REGION H

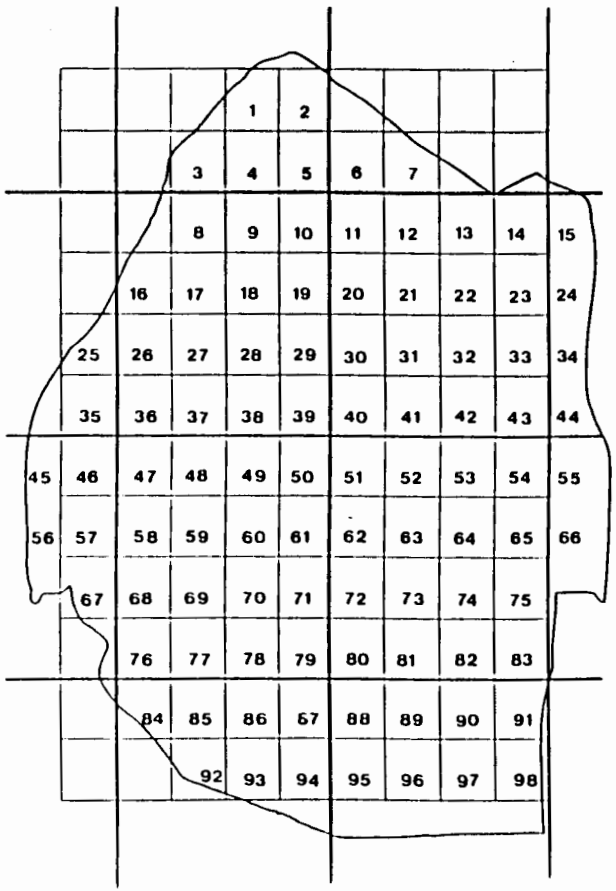
SPECIES	REPORTING RATE
BLACKEYED BULBUL	0.97
RATTLING CISTICOLA	0.96
YELLOWEYED CANARY	0.95
GREENSPOTTED DOVE	0.95
BLUE WAXBILL	0.94
FORKTAILED DRONGO	0.94
WHITEBROWED ROBIN	0.93
GLOSSY STARLING	0.92
CAPE TURTLE DOVE	0.92
CHINSPOT BATIS	0.91
LONGBILLED CROMBEC	0.90
WHITEBELLIED SUNBIRD	0.87
REDFACED MOUSEBIRD*	0.87

REGION I

SPECIES	REPORTING RATE
RATTLING CISTICOLA	1.00
WHITEBROWED ROBIN	1.00
BLUE WAXBILL	1.00
YELLOWEYED CANARY	0.97
LONGBILLED CROMBEC	0.97
CHINSPOT BATIS	0.97
BLACKEYED BULBUL	0.95
CAPE TURTLE DOVE	0.95
FORKTAILED DRONGO	0.95
GREENSPOTTED DOVE	0.90
SOMBRE BULBUL	0.90
SOUTHERN BOUBOU	0.90
GLOSSY STARLING	0.90

FIG 1a. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO THEIR GEOGRAPHICAL LOCATIONS.



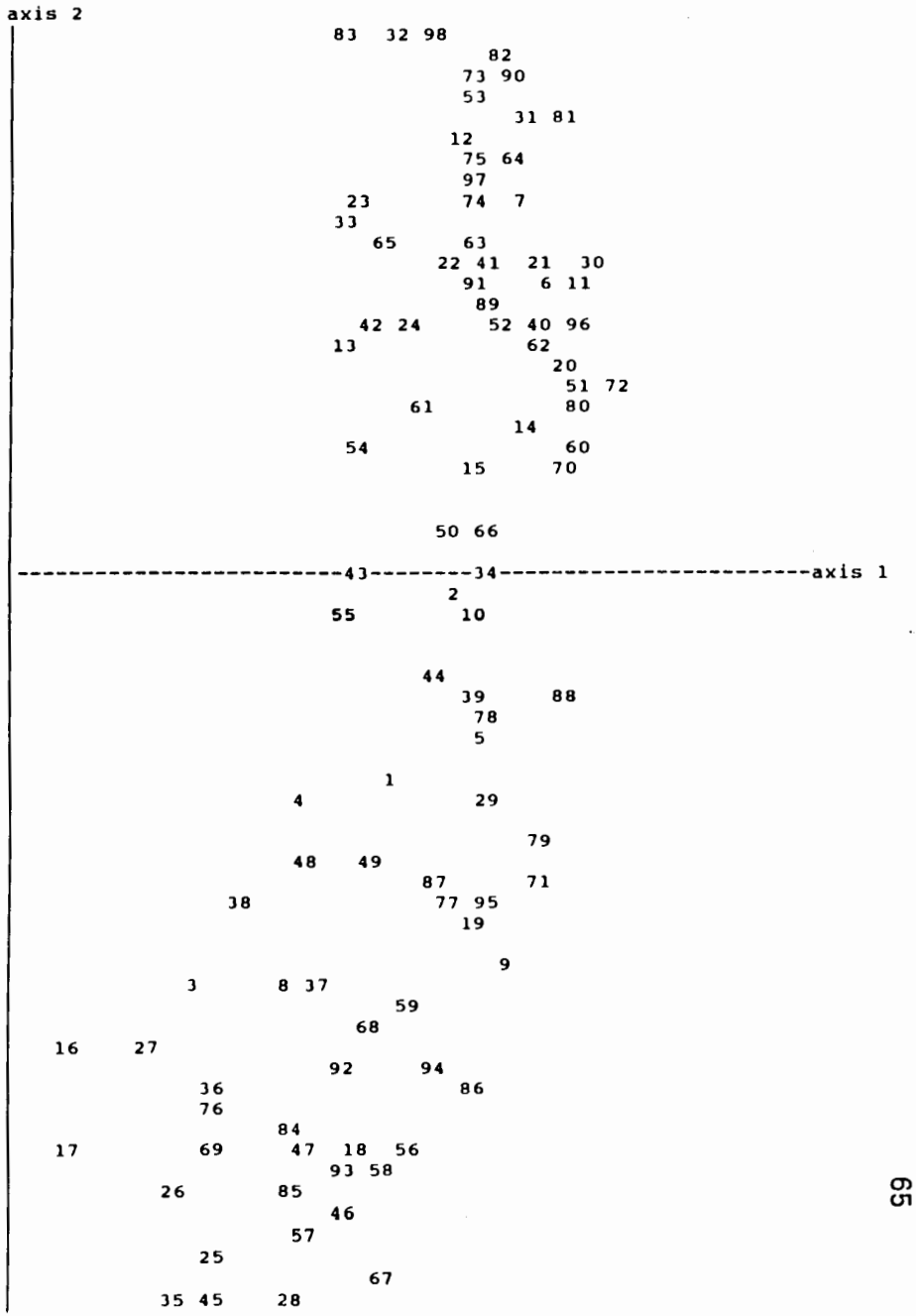
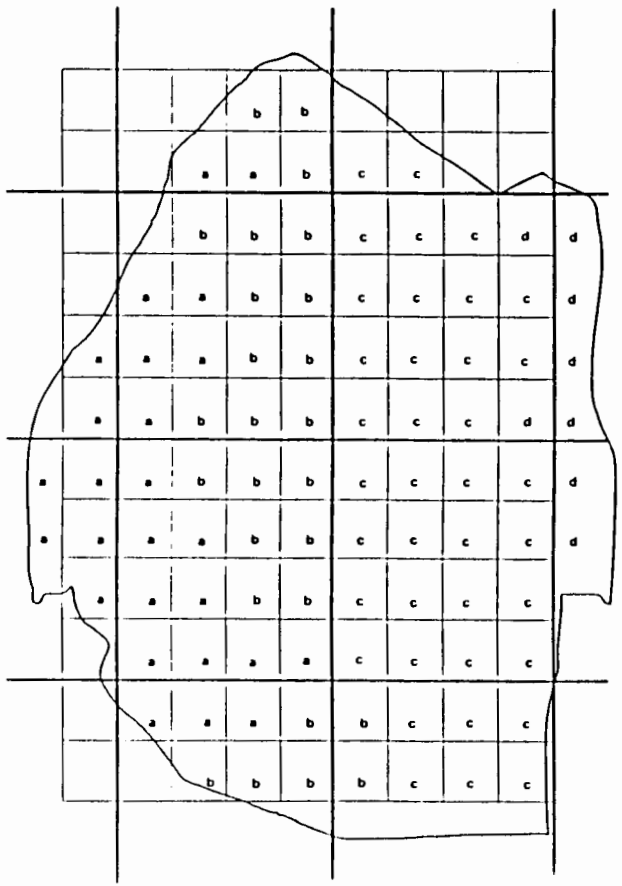


FIG 1b. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO TOPOGRAPHIC REGIONS.



TOPOGRAPHIC REGIONS

A=HIGHVELD
B=MIDDLEVELD
C=LOWVELD
D=LUBOMBOS

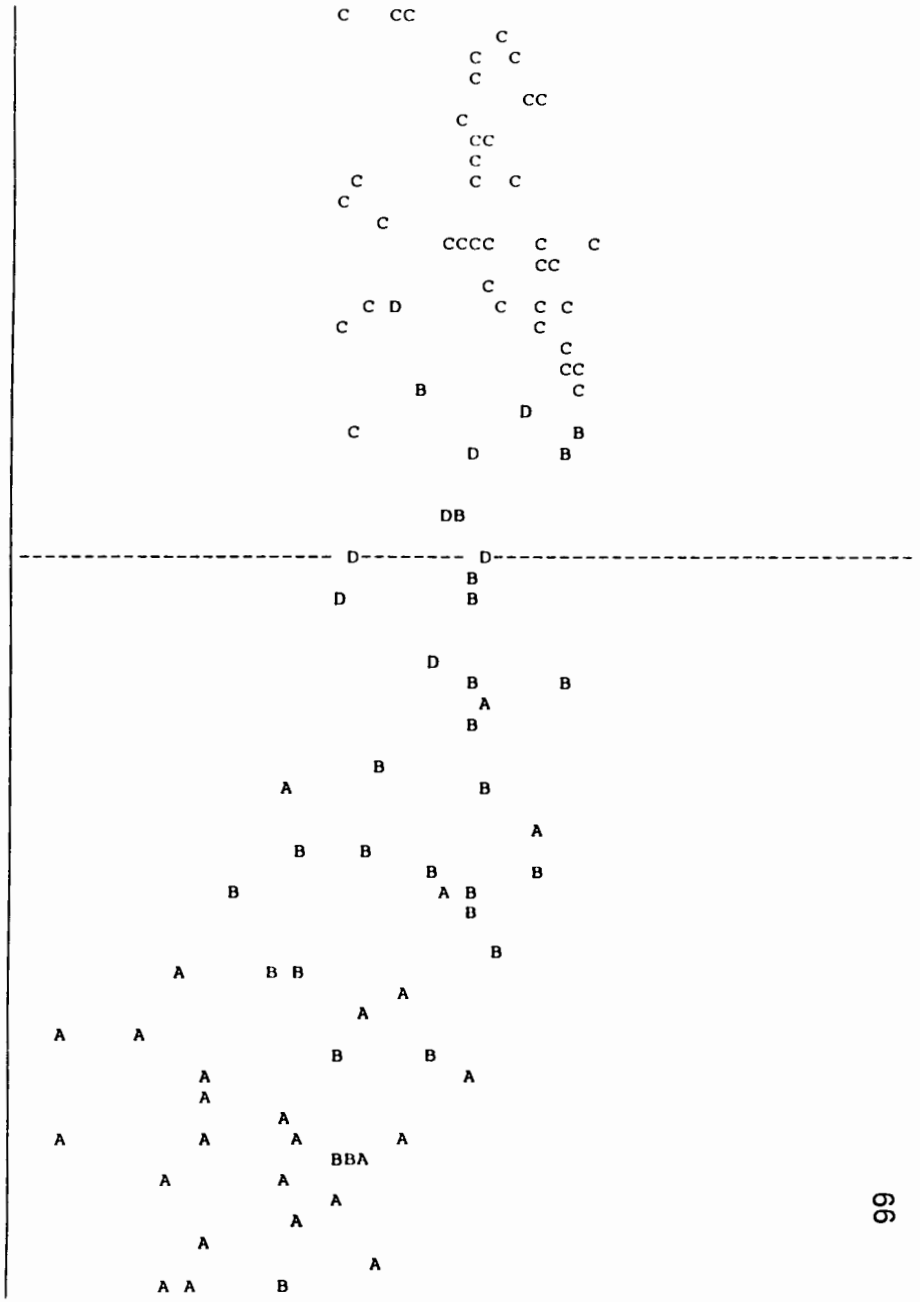
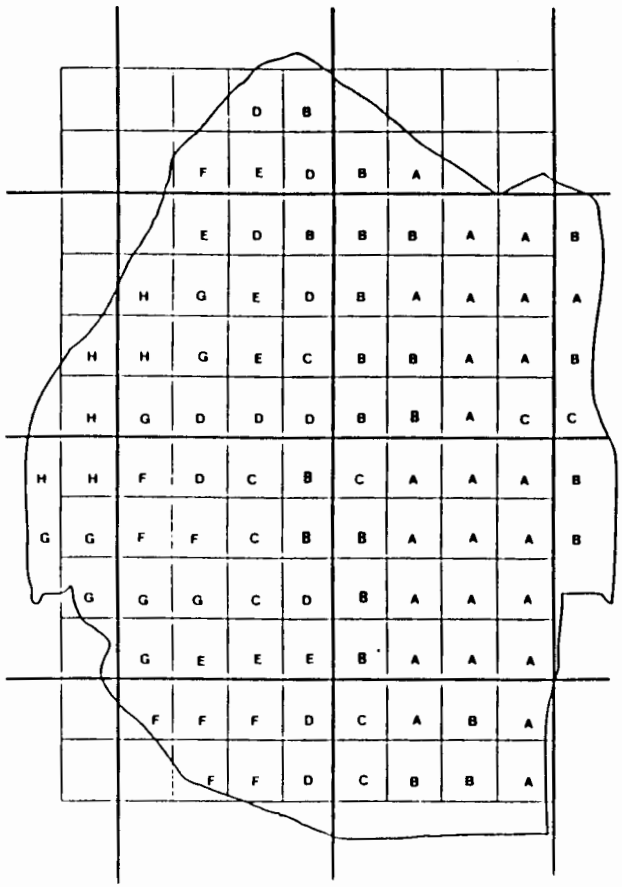


FIG 1c. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO ALTITUDE CLASSES.



ALTITUDE CLASSES

A=<200 m
B= 200-400 m
C= 400-600 m
D= 600-800 m
E= 800-1000 m
F=1000-1200 m
G=>1200 m

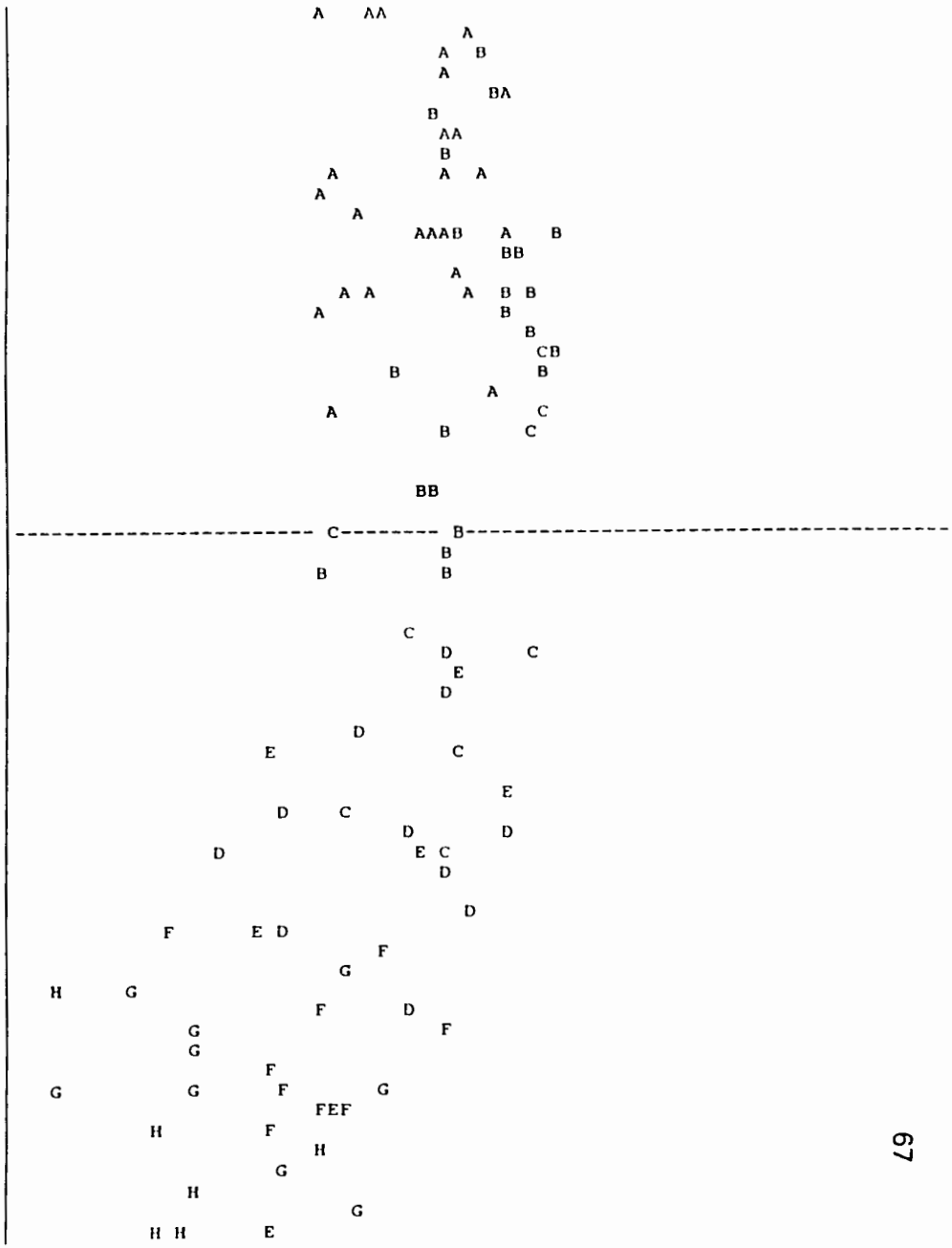
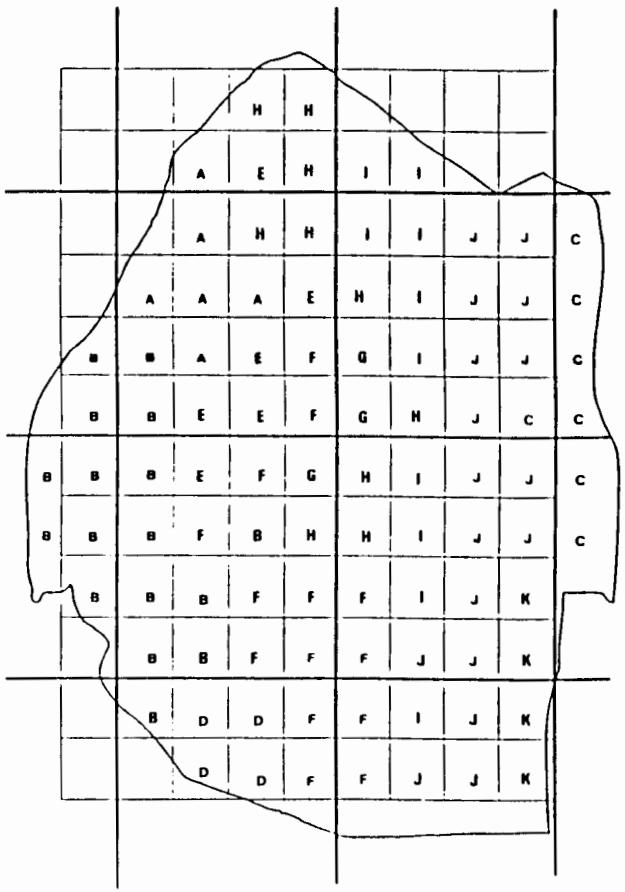


FIG 1d. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO VEGETATION TYPES (GOUDIE & PRICE-WILLIAMS 1979)



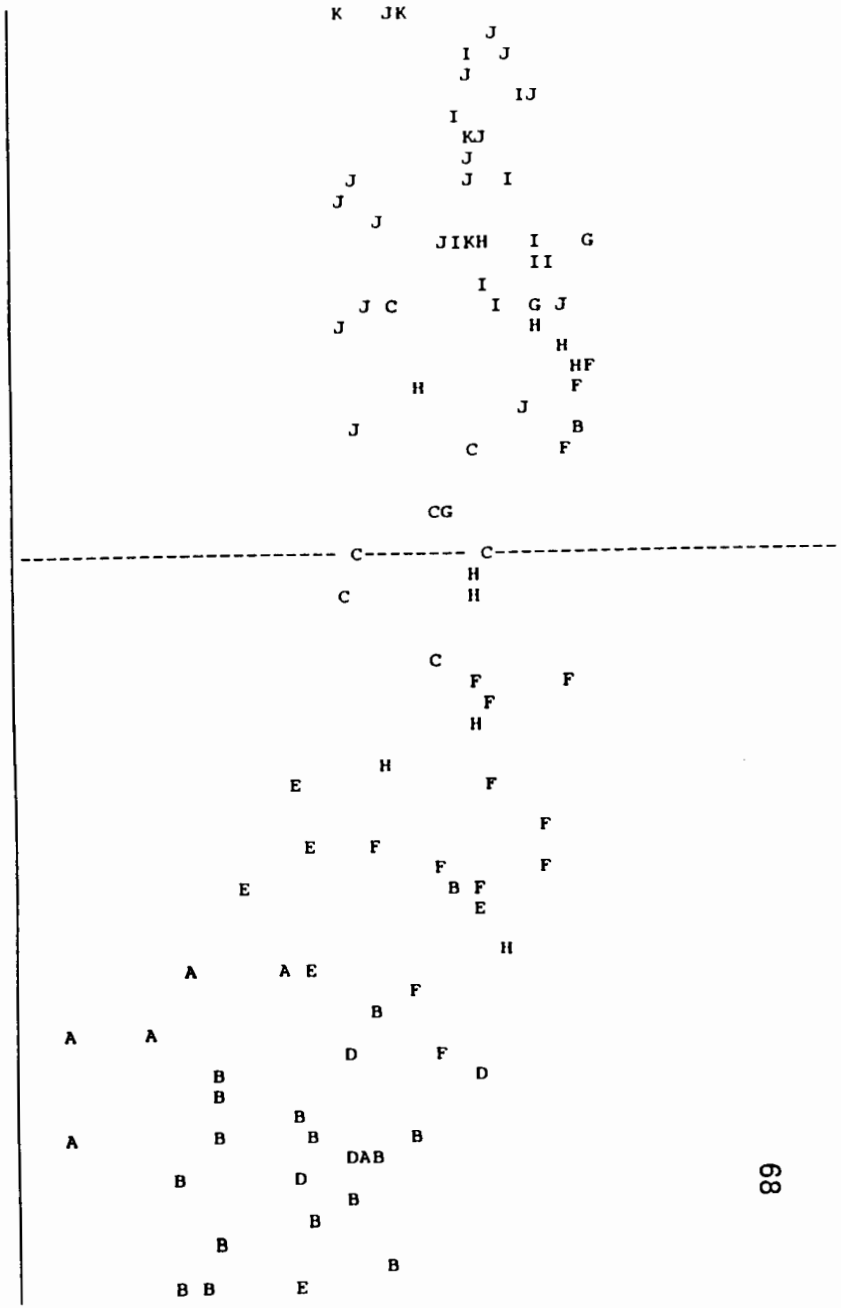
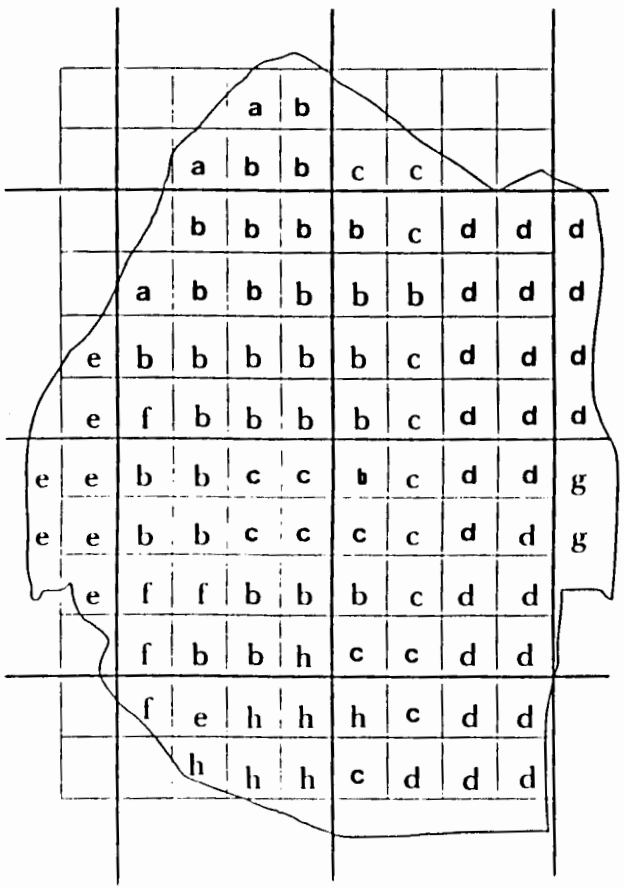


FIG 1e. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO ECOREGIONS.



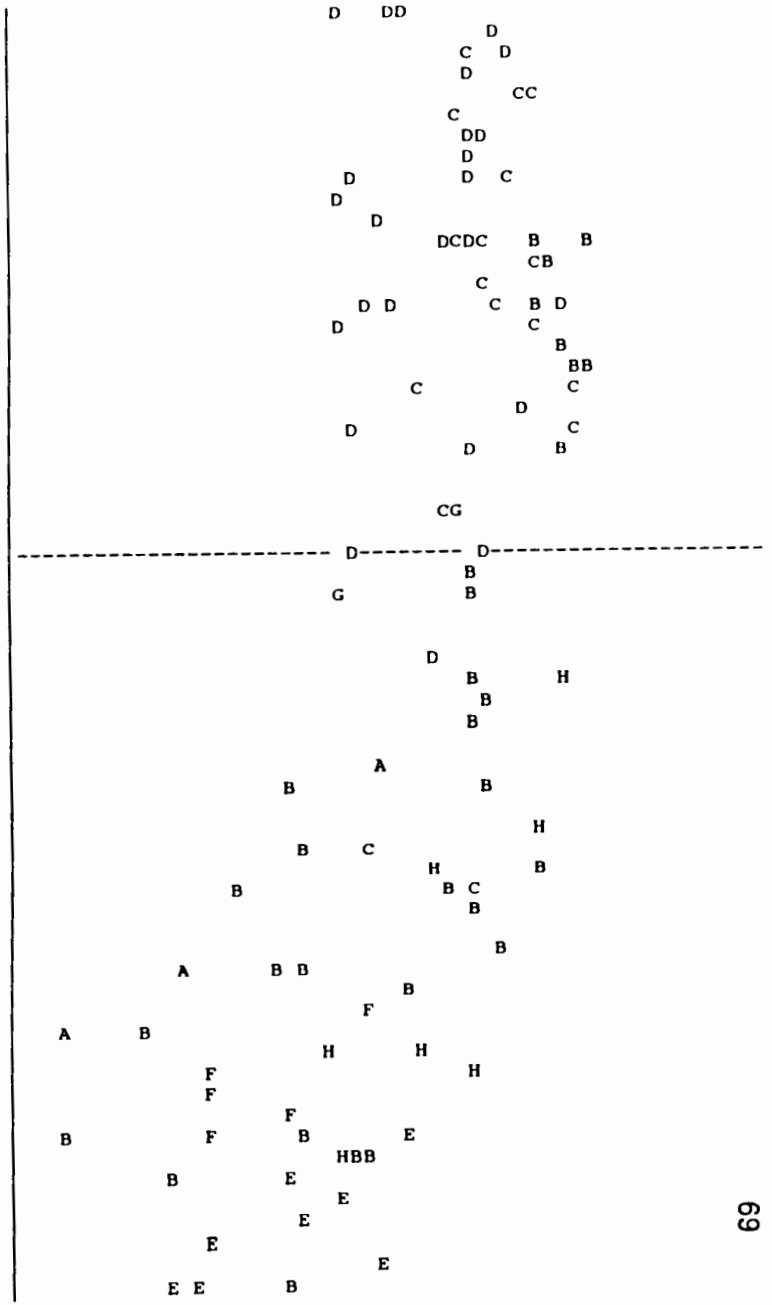
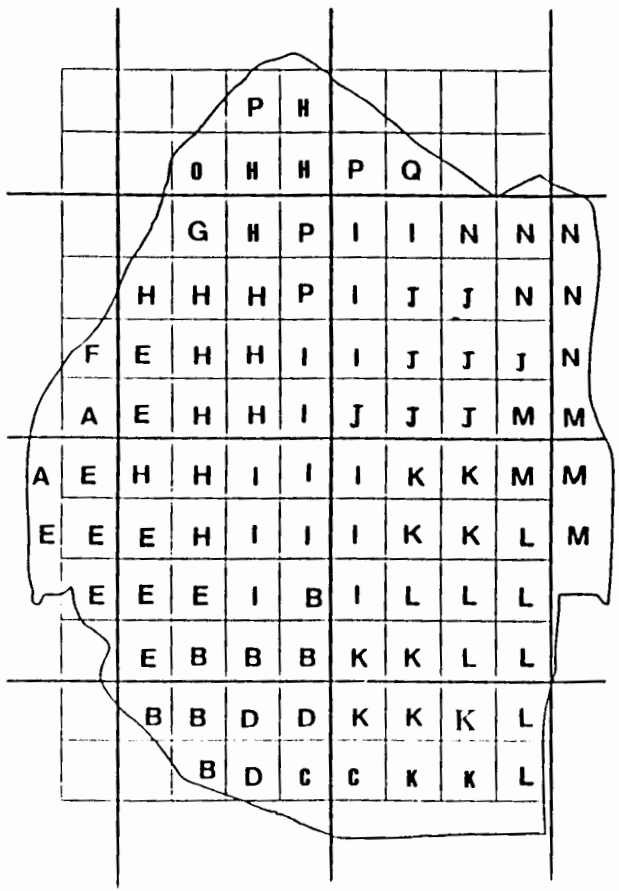


FIG 1f. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO BIOCLIMATIC REGIONS.



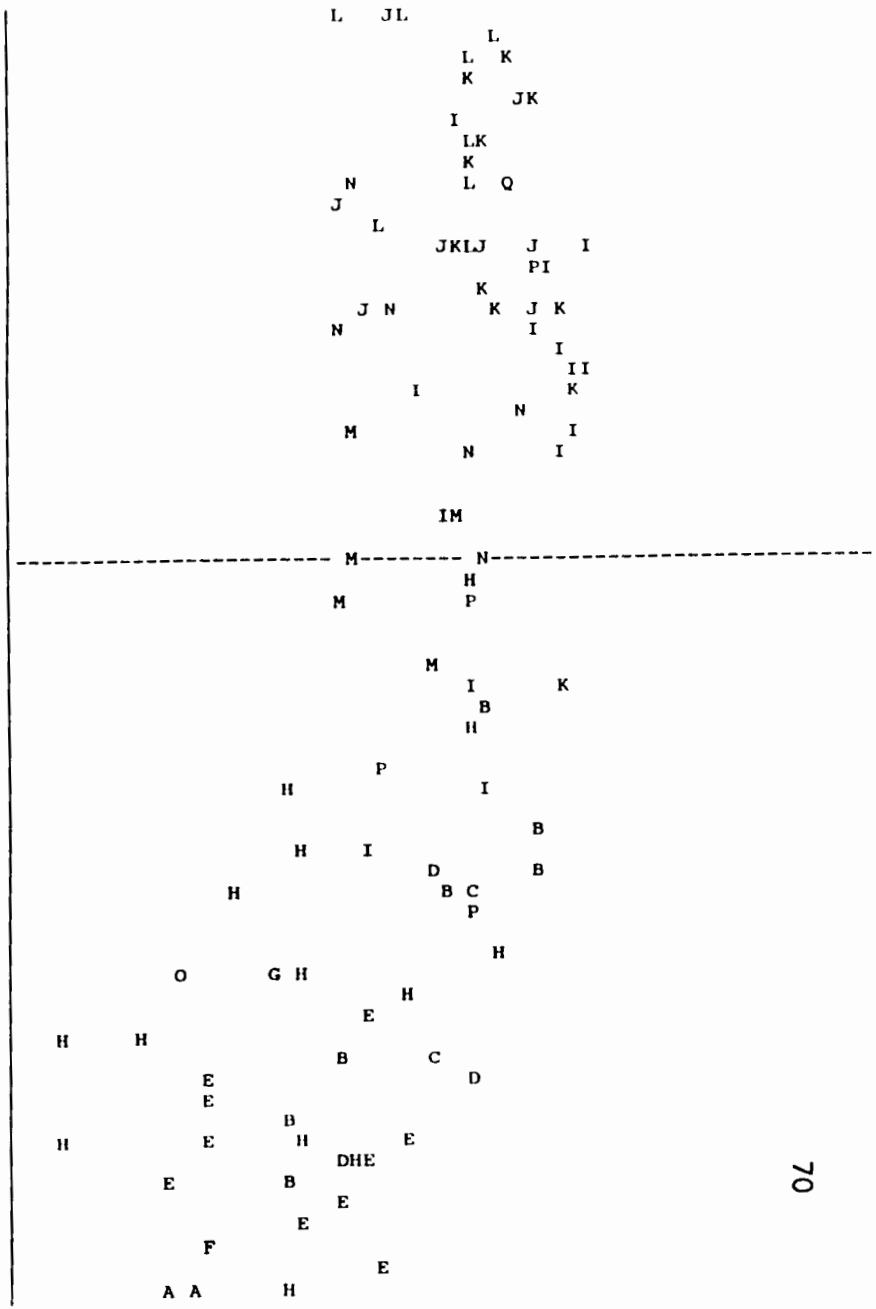
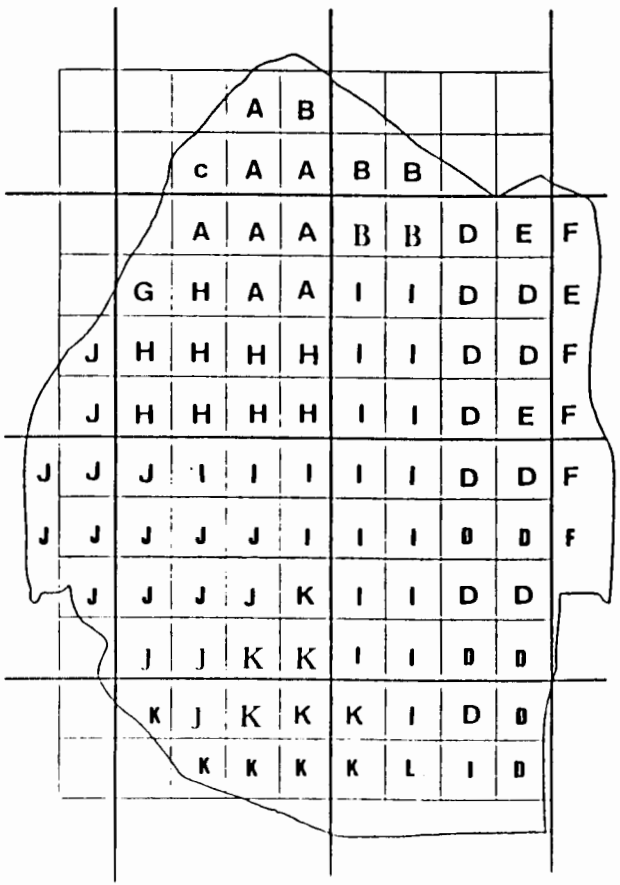


FIG 1g. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO LANDFACE REGIONS.



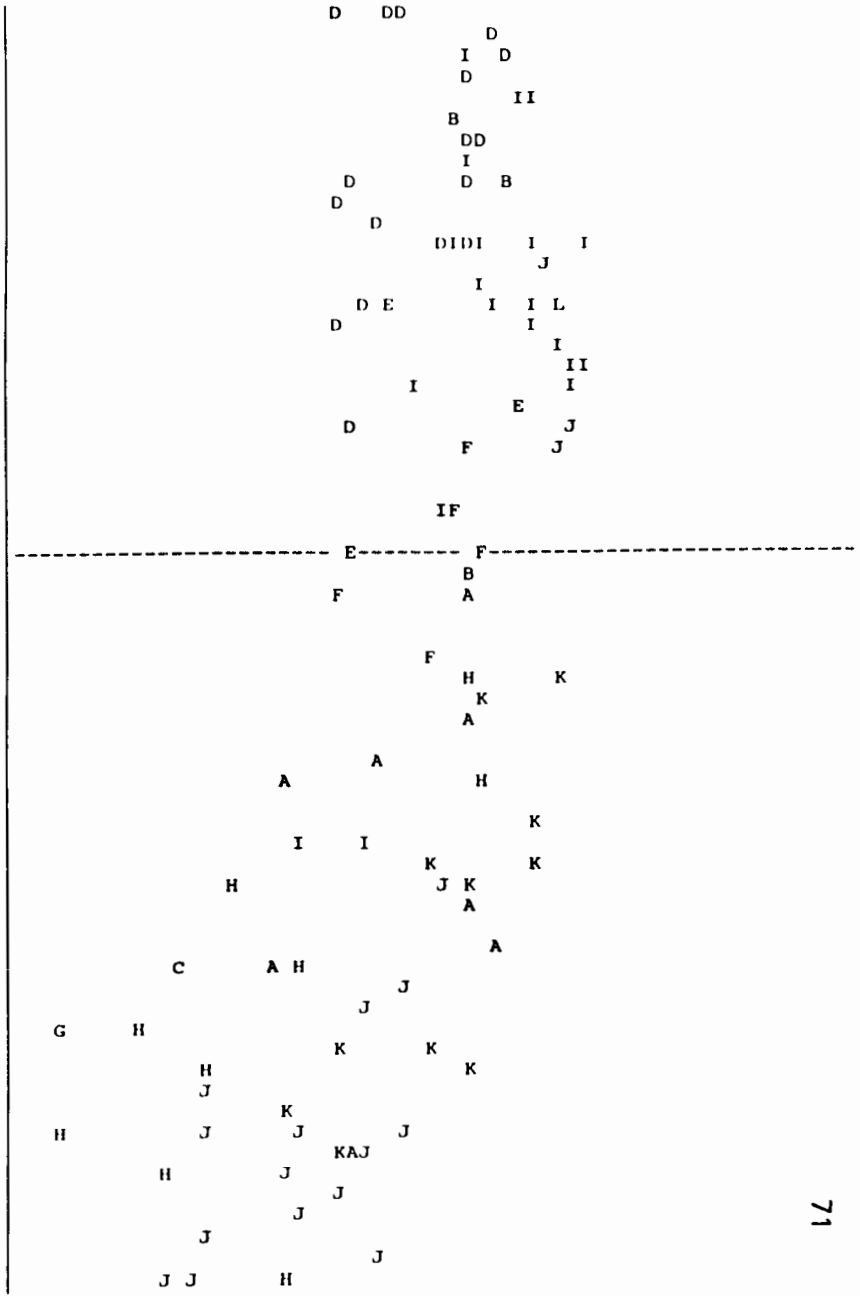
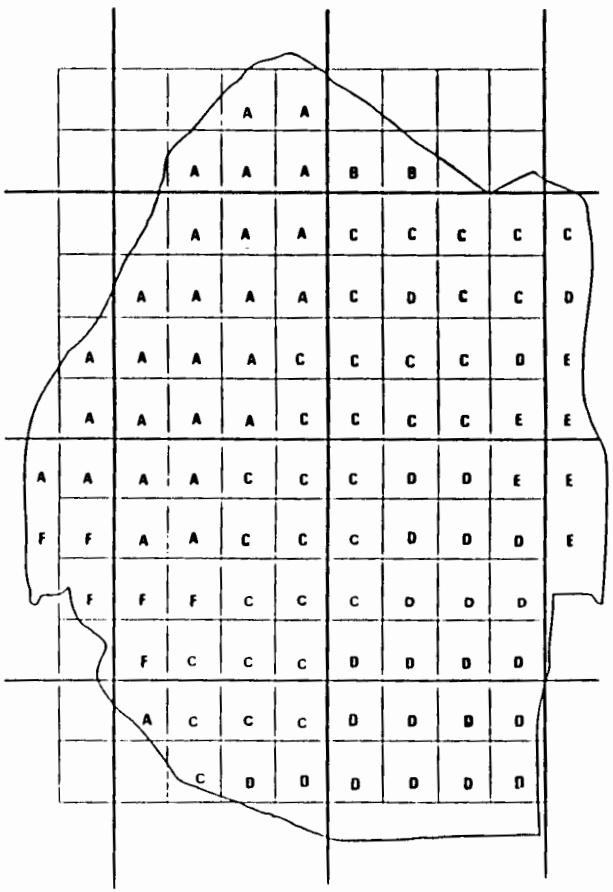


FIG 1h. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO PRIMARY PRODUCTIVITY.



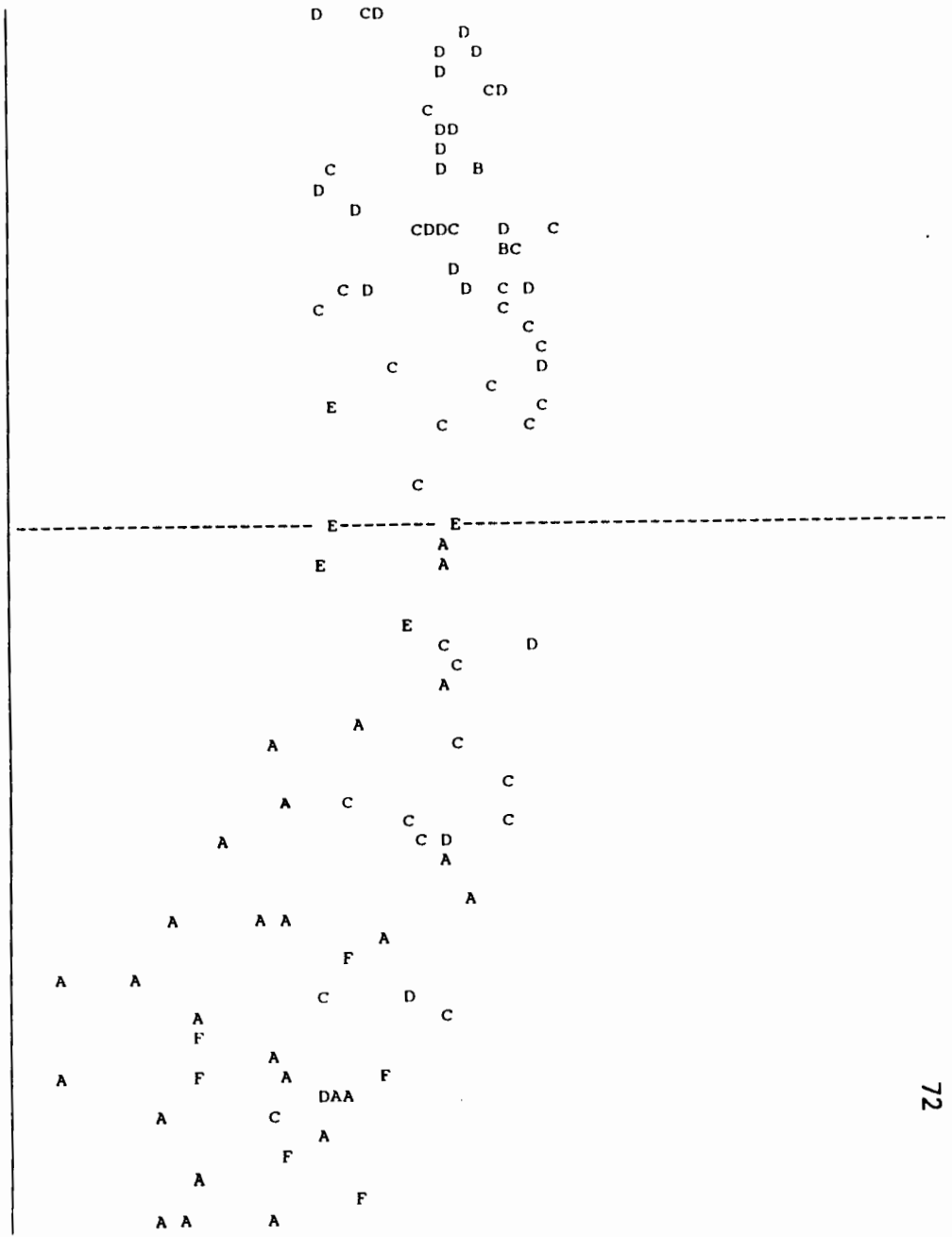
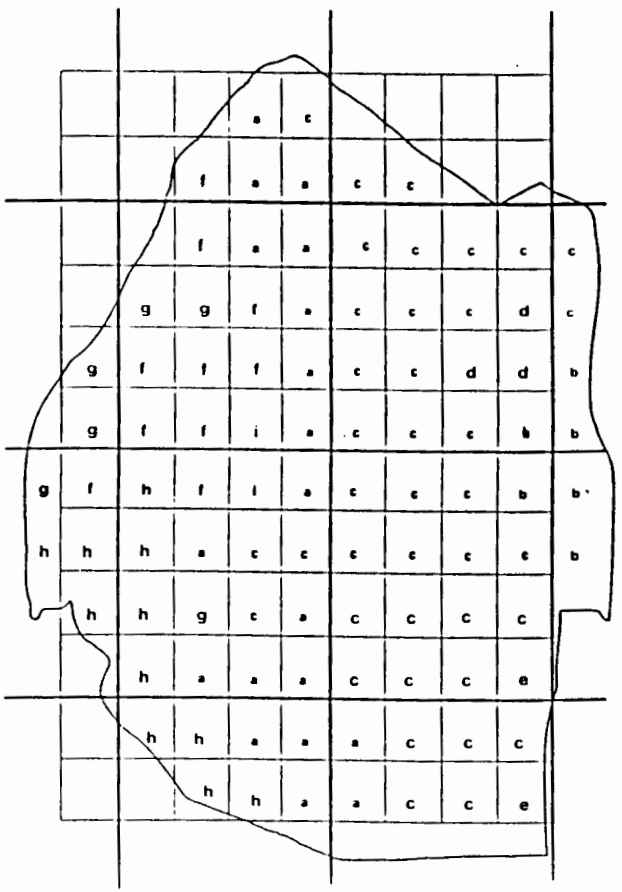


FIG 1i. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING GRID SQUARES IN RELATION TO AVIFAUNAL REGIONS (AVERAGE LINKAGE).



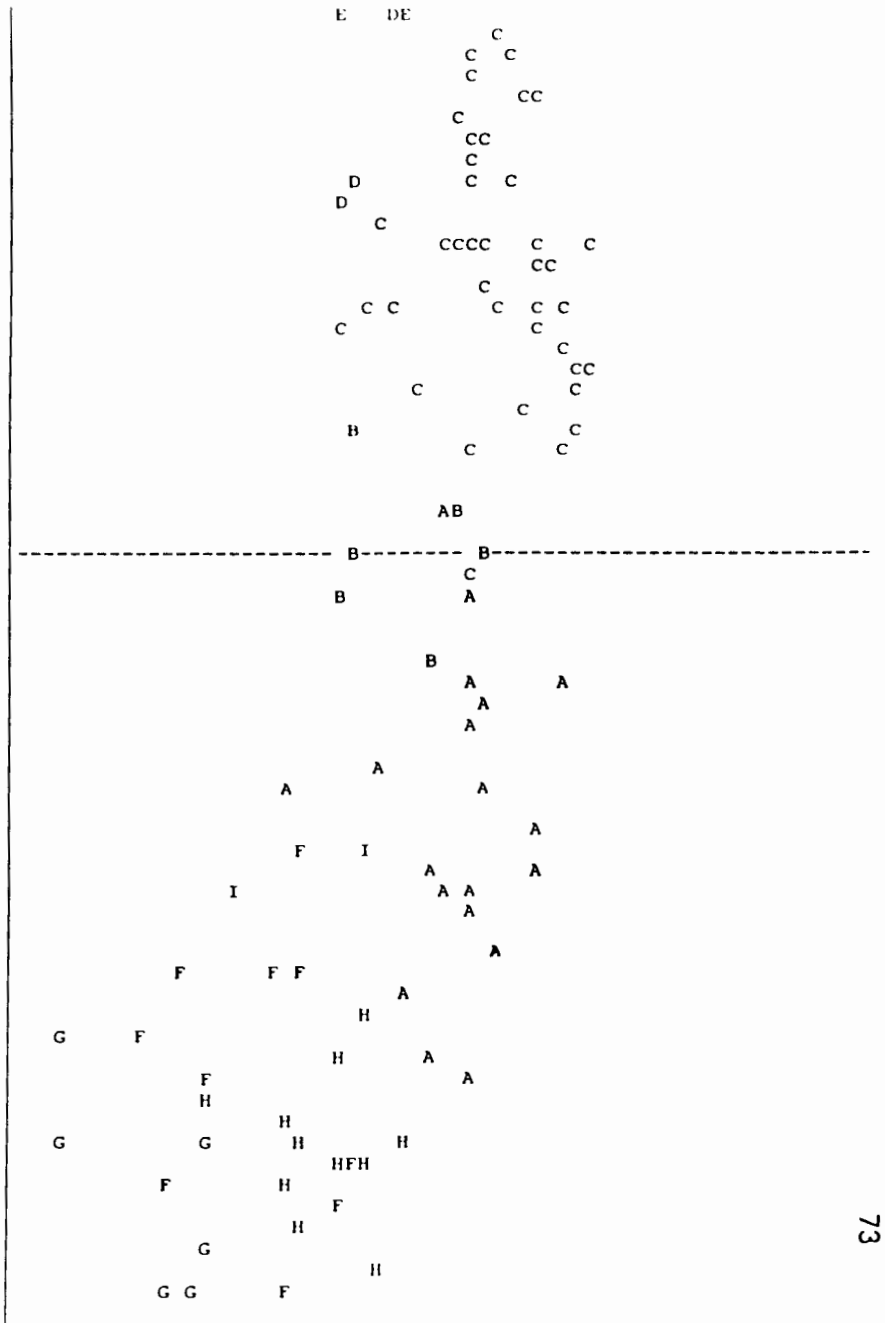
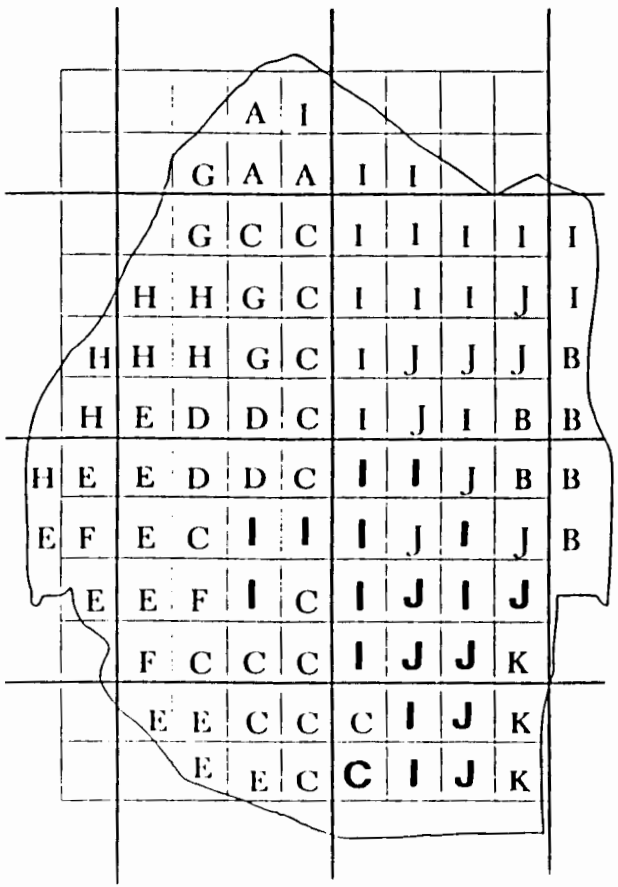
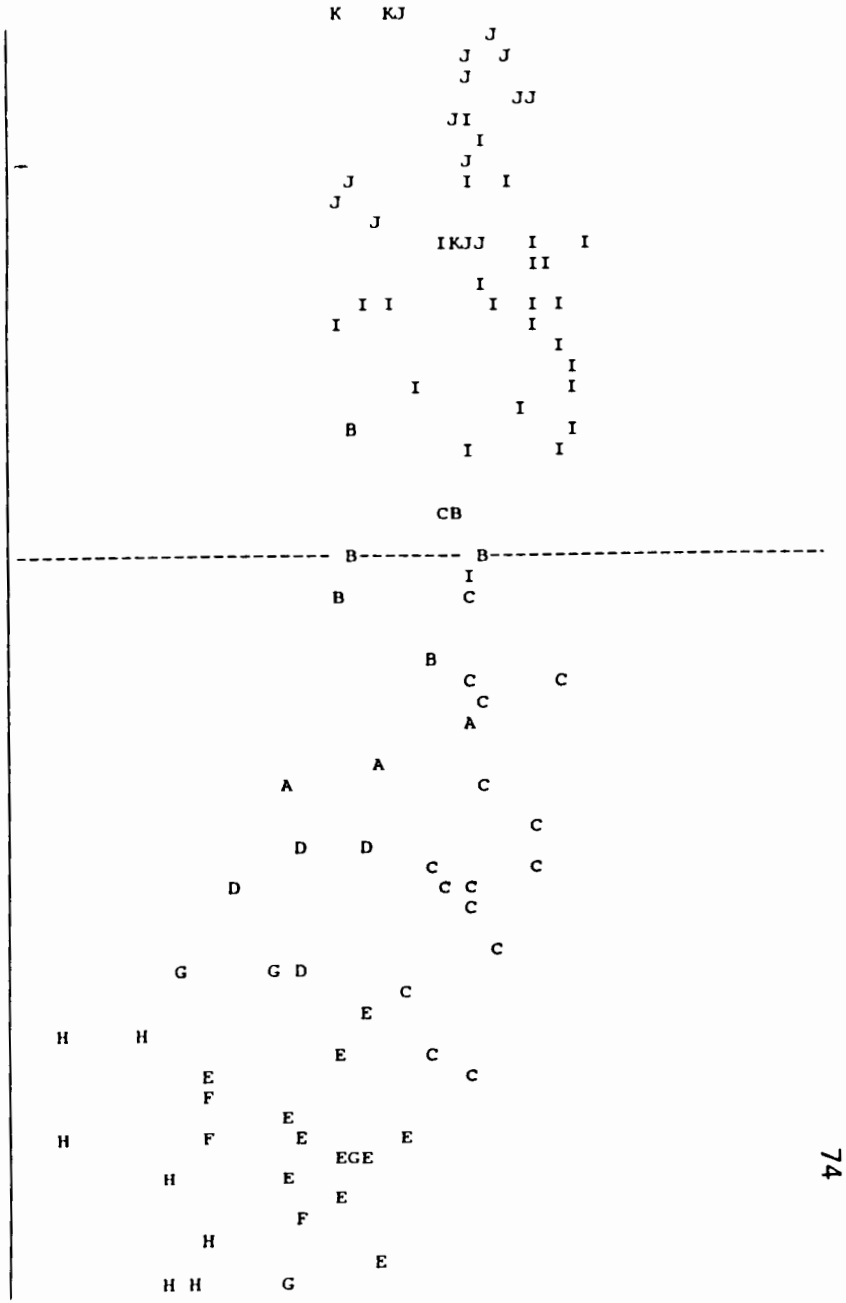


FIG 1j. PRINCIPAL COMPONENTS BIPLOT

POSITIONS OF POINTS REPRESENTING
GRID SQUARES IN RELATION TO
AVIFAUNAL REGIONS (COMPLETE LINKAGE).





CONCLUSION

The Southern African Bird Atlas Project has demonstrated that bird atlas projects have the potential to generate vast amounts of distributional data for bird species at relatively little cost (Harrison 1992). It is hoped that the techniques developed in the course of this investigation might be applied to other atlas data sets in order to extract additional insights into the nature of the distribution patterns.

ACKNOWLEDGEMENTS

Fieldwork in Swaziland was supported by the Conservation Trust of Swaziland, the Southern African Ornithological Society and the Natural History Society of Swaziland.

I acknowledge the assistance of Prof. L.G. Underhill. Advice was received from Prof. J.M. Juritz and J. Harrison and R. Navarro assisted with transforming the bird atlas data into the required format. Dr. A. Lombard assisted with extracting data from GIS databases. Mrs F. Train assisted with word processing and printing the manuscript. Rainfall data were obtained from the Computing Centre for Water Research, University of Natal, Pietermaritzburg. The Landface database was supplied by Prof. W. van Riet of GISlab, University of Pretoria, the Ecoregions database by the Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria and the Primary Productivity and Climatic Zones databases by the Department of Agricultural Engineering, University of Natal, Pietermaritzburg.

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APPENDIX 1

Calculation of the Sums of Squares Index (SSI) for a classification of M localities with N categories, with n_i localities in category i, from the co-ordinates $(x_{ij}; y_{ij})$ of the points representing localities in the biplot in two dimensions.

$$TSS = \sum_{i=1}^{N} \sum_{j=1}^{n_i} (x_{ij}^2 + y_{ij}^2)$$

(Sum of squares of Euclidean distances of locality points from the origin).

$$X_{ci} = \left(\sum_{j=1}^{n_i} x_{ij}\right) / n_i \quad ; \quad Y_{ci} = \left(\sum_{j=1}^{n_i} y_{ij}\right) / n_i \quad ; \quad i = 1, \ldots, N$$

(Co-ordinates of the centroids of the categories)

$$WSS = \sum_{i=1}^{N} \sum_{j=1}^{n_i} ((x_{ij} - X_{ci})^2 + (y_{ij} - Y_{ci})^2)$$

(Sum of squares of distances of locality points from centroids of respective categories)

$$SSI = 100 \left(\frac{WSS}{TSS}\right) .$$

(Note: If $BSS = \sum_{i=1}^{N} n_i (X_{ci}^2 + Y_{ci}^2)$ then TSS = WSS + BSS ie. total sums of squares = whithin categories sums of squares + between categories sums of squares)

SWAZILAND BIRD ATLAS

1985 - 1991

BY

VINCENT PARKER

TABLE OF CONTENTS

INTRODUCTION

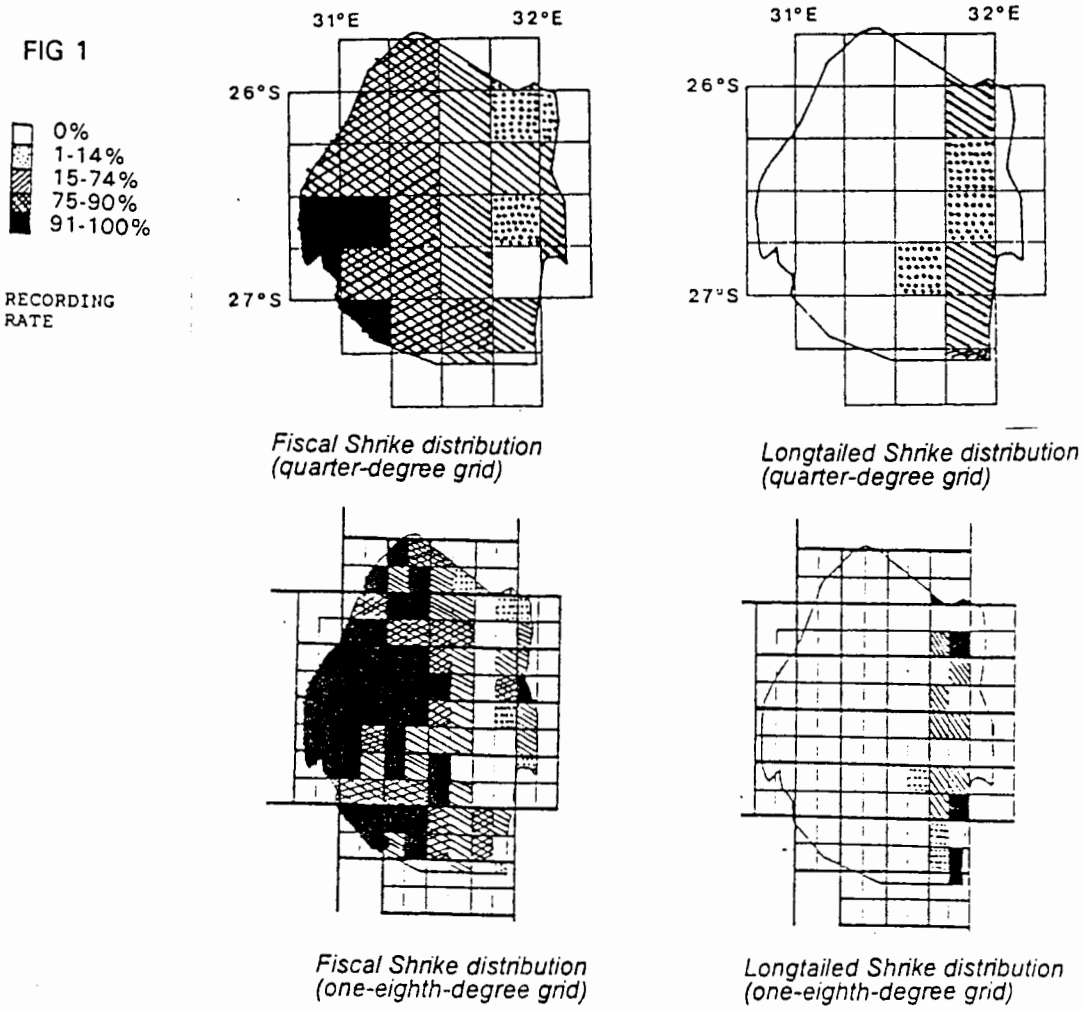
The Swaziland Bird Atlas describes the geographical distribution, seasonality and relative abundance of all bird species known to have occurred within Swaziland during the period 1985 to 1991.

The geographical distribution of each species is described in terms of a 1/8 degree grid, whereby each grid unit comprises 1/8 of a degree of latitude by 1/8 of a degree of longitude and is roughly square with sides of approximately 12.5 km.

The 1/8 degree grid was selected as the finest grid for which it was practically possible to compile adequate data for each grid unit during the time available for the project. Since all other bird atlases already published or in preparation within southern Africa have employed a 1/4 degree grid, the Swaziland Bird Atlas presents a finer definition of bird distribution patterns than has hitherto been attempted in the region.

The distribution maps for the Longtailed Shrike and the Fiscal Shrike illustrate well the merit of the finer grid. FIG. 1 compares the 1/4 degree and 1/8 degree distribution maps for each of these two species. The 1/8 degree map shows that Longtailed Shrikes occur only in the far eastern section of the Swaziland lowveld, where the vegetation is predominantly knobthorn-marula savanna. The Fiscal Shrike is completely absent from the same area, though common elsewhere in the lowveld. The distinction between the eastern knobthorn-marula savanna dominated lowveld and the more mixed western lowveld is obscured on the coarser 1/4 degree grid. Distribution maps on the 1/4 degree grid in fact create the erroneous impression that these two shrike species overlap much of the range of the longtailed shrike.

FIG 1



Fiscal Shrike distribution (quarter-degree grid)

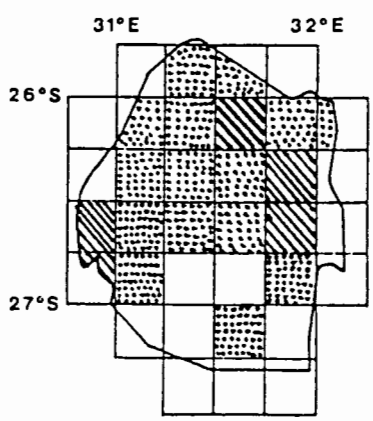
Longtailed Shrike distribution (quarter-degree grid)

Fiscal Shrike distribution (one-eighth-degree grid)

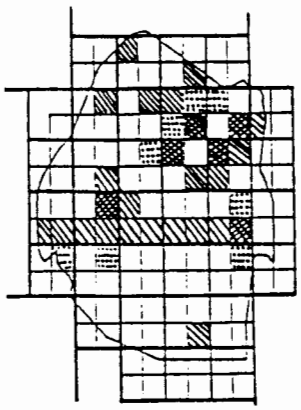
Longtailed Shrike distribution (one-eighth-degree grid)

Similarly, FIG 2 compares the distribution maps for the water dikkop on the 1/4 and 1/8 degree grids. Comparison of the 1/8 degree map with the major river systems of Swaziland illustrates very clearly the habitat preference of the species. By comparison, the 1/4 degree map is far less informative.

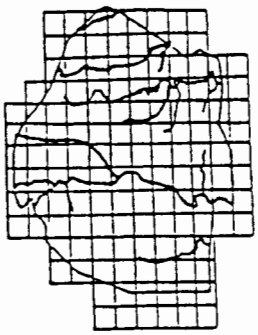
FIG 2



Water Dikkop distribution (quarter-degree grid)



Water Dikkop distribution (one-eighth-degree grid)



Swaziland: Major Rivers

METHODS

For each of the 100 1/8 degree grid units which fall entirely or mostly within Swaziland, species lists were drawn up for each month of the year. Each species list was based on at least one field trip of at least five daylight hours duration by the author. During each field trip, each of the different habitat types identified within a grid unit were visited, and as far as possible, all possible bird species present were identified and listed. For a few grid units, additional species lists were submitted for each month by other observers as well as the author.

An average of 80 bird species were listed in every grid unit in each month, with a minimum of 35 (excluding some units which lie mostly outside Swaziland). At least 50 species were listed on 98% of the species lists per unit per month. Table 1 lists the numbers of species recorded in each grid unit in each month.

TABLE 1

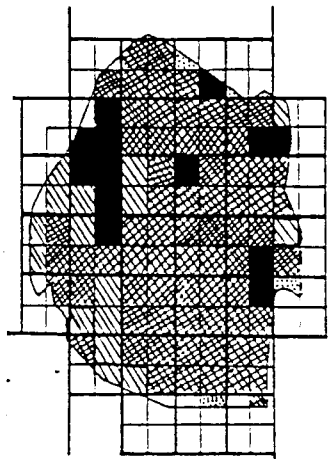
NUMBERS OF SPECIES RECORDED PER GRID UNIT PER MONTH.

UNIT	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
A5 Entonjeni	89	91	61	87	81	87	80	73	89	85	99	84	195
A6 Ngonini	92	100	66	86	68	73	76	57	87	68	105	115	202
A7 Mayiwane	34	30	40	32	40	28	35	29	28	45	51	38	105
B4 Piggs Peak	84	74	68	81	53	67	90	82	105	104	97	85	178
B5 Rocklands	103	55	70	98	87	95	68	95	112	114	89	107	194
B6 Jacks	87	84	77	61	55	61	72	67	79	88	94	72	164
B7 Ntabinezimpisi	76	68	59	61	54	51	63	74	63	64	78	79	147
B8 Sihhoye	125	104	115	100	104	89	77	101	83	112	131	132	220
B9 Ricelands	87	63	75	60	67	51	75	69	57	72	76	76	186
C4 Mbojane	96	103	90	91	83	80	89	88	109	119	121	112	208
C5 Mhlambongwenya	73	51	63	60	56	72	69	80	88	82	90	86	169
C6 St Peregrines	105	105	78	91	75	92	79	107	98	91	102	91	209
C7 Balegane	106	98	91	87	77	79	63	84	92	85	91	89	185
C8 SRD	104	89	96	87	78	67	66	70	80	104	109	119	203
C9 Mhlume	136	90	90	102	78	69	87	76	92	114	112	98	229
C10 Tambankulu	82	73	77	85	72	66	71	65	65	81	80	80	177
C11 Duma	70	64	66	60	64	50	53	59	75	60	73	65	166
D3 Hawane	130	119	112	108	121	104	126	106	119	130	126	148	242
D4 Enkhaba	100	84	92	70	78	66	62	76	74	86	76	93	173
D5 Maphalaleni	70	49	75	61	63	55	53	69	54	84	63	79	150
D6 Meleka	64	51	61	56	56	65	51	62	64	82	62	68	149
D7 Croyden	80	80	90	79	70	57	90	81	90	103	102	91	197
D8 Mnjoli dam	116	114	105	92	78	104	103	89	67	131	128	111	219
D9 Ngomane	119	116	90	109	72	90	82	78	111	119	135	135	223
D10 Simunye	209	195	181	179	177	148	185	159	194	196	226	205	311
D11 Mlawula	175	131	155	166	162	141	174	166	176	196	180	161	288
E2 Lundzi	81	67	47	53	59	45	67	58	44	68	67	91	138
E3 Tonkwane	73	94	89	66	72	75	77	80	84	93	90	81	155
E4 Mbabane	117	112	91	77	81	79	82	100	92	119	103	115	194
E5 Tea Road	62	55	50	47	51	50	55	58	61	68	56	61	127
E6 Luve	64	70	76	70	72	65	79	74	79	74	83	69	172
E7 Dinedor	133	122	106	114	129	126	117	145	145	146	144	127	242
E8 Panata	83	78	77	75	58	66	63	71	73	95	94	87	164
E9 Hlane	104	103	97	62	72	64	83	87	84	110	81	57	183
E10 Cyrildene	106	81	71	125	122	84	114	97	117	100	115	125	243
E11 Mhlumeni	73	65	66	74	57	67	65	51	73	64	76	77	151
F2 Etjaneni	64	52	65	55	53	54	53	45	59	66	61	67	130
F3 Mhlambanyatsi	72	55	40	60	60	57	59	61	78	57	88	66	149
F4 Ezulweni	99	126	92	66	97	73	87	99	116	83	127	120	208

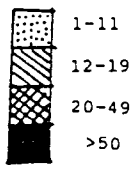
F5 Kwa Luseni	64	51	58	52	43	50	41	51	45	63	52	65	143
F6 Manzini	82	64	70	58	68	59	69	88	80	77	113	91	169
F7 Mafutseni	121	139	125	84	89	63	98	107	117	111	127	118	217
F8 Malindza	78	71	68	73	61	61	59	61	70	82	79	75	162
F9 Mpaka	77	76	79	79	91	86	75	80	86	108	115	68	214
F10 Siteki	98	82	94	87	88	89	102	95	82	96	94	88	200
F11 Sitsatsaweni	70	72	77	79	62	67	77	58	76	83	73	98	174
G1 Sandlane	68	53	67	48	54	53	50	53	57	59	72	64	136
G2 Usutu	64	72	72	65	53	50	55	59	52	57	70	88	153
G3 Bhunya	65	58	54	58	56	50	46	42	64	53	74	58	136
G4 Malkerns	183	172	183	166	158	163	180	189	160	193	210	179	288
G5 Matshapha	103	86	86	104	83	80	74	114	114	110	109	106	210
G6 Olwandle	62	82	88	76	74	61	60	66	68	80	84	84	170
G7 Gilgal	74	60	67	57	59	63	53	67	70	80	76	72	142
G8 Mapokwe	84	102	55	65	73	51	56	64	61	54	76	80	152
G9 Magombe	79	80	60	57	58	63	85	85	93	84	82	99	177
G10 Jabane	81	90	88	95	81	83	100	80	85	122	111	123	233
G11 Jilobi	70	70	47	69	69	65	62	64	75	71	73	65	152
H1 Dwalile	75	66	77	55	63	50	55	35	69	89	84	73	165
H2 Mbulungeni	68	53	63	64	51	50	63	59	55	63	81	66	143
H3 Mankayane	57	63	69	69	57	57	52	69	69	73	82	69	158
H4 Ntungulu	87	57	67	65	67	54	58	42	74	94	75	96	182
H5 Gebeni	70	72	70	84	71	70	67	63	75	88	83	77	159
H6 Sidvokodvo	91	98	101	84	73	71	65	67	91	98	101	92	195
H7 Syringa	73	74	73	52	64	58	64	61	65	67	69	83	148
H8 Siphofaneni	86	70	68	72	101	81	65	65	82	75	87	62	180
H9 Tambuti	84	84	90	78	85	70	94	78	84	110	79	64	195
H10 Sifunga	154	129	124	119	136	119	135	109	121	174	170	134	267
H11 Tikuba	72	62	68	61	70	61	55	62	76	83	81	74	149
I2 Sicunusa	74	66	65	66	65	62	66	75	70	67	84	76	161
I3 Masusa	75	69	57	66	54	56	59	57	64	65	82	73	136
I4 Mahlangatja	60	53	58	58	53	43	54	45	55	52	63	54	139
I5 Nyonyali	83	74	69	67	67	51	52	61	70	64	87	73	156
I6 Ka Phunga	73	86	77	64	62	58	52	78	73	92	94	76	165
I7 Singceni	73	78	78	63	69	65	69	69	81	80	74	95	165
I8 Sakhilena	67	65	67	62	54	64	50	55	66	73	78	63	152
I9 St Phillips	74	89	74	86	78	73	77	89	65	79	91	90	196
I10 Big Bend	191	181	179	156	121	142	160	183	170	177	205	178	300
I11 Nkonjane	62	51	-	-	50	66	57	83	-	58	78	76	174
J3 Gege	60	71	63	51	54	55	60	56	67	61	65	62	140
J4 Madhlolo	72	74	72	63	72	60	65	48	76	87	91	77	160
J5 Hlatikulu	78	69	66	73	77	70	63	79	86	93	78	86	182
J6 Kubutsa	67	72	67	70	54	62	72	64	78	85	75	80	161
J7 Sithobela	67	81	79	76	60	63	77	70	70	81	90	84	166
J8 Rondspring	94	106	90	78	64	64	54	69	59	98	89	94	183
J9 Mkandvuva	79	91	94	86	83	75	74	54	71	92	88	68	187
J10 Ndzevane	87	89	82	67	75	67	66	81	73	100	103	102	181
K3 Mahamba	68	71	82	68	64	51	64	74	95	88	93	76	168
K4 Nhlangano	64	61	54	50	63	50	51	64	61	74	74	68	145
K5 Edwaleni	59	63	73	66	52	58	63	59	74	89	84	76	158
K6 Mooiplaats	79	77	88	79	63	63	66	54	66	91	80	86	163
K7 Nzila	78	72	76	56	54	66	66	65	64	72	70	61	140
K8 Maloma	77	84	78	63	52	74	54	63	74	82	86	79	166
K9 Ngwavuma	84	61	82	72	63	76	72	78	69	87	73	79	161
K10 Nsoko	119	81	103	87	112	53	66	78	117	101	128	106	229
L4 Makhosini	48	55	52	53	35	52	40	40	40	62	65	54	133
L5 Mtombe	51	53	54	53	52	58	56	52	70	65	68	56	144
L6 Mhlosheni	77	83	77	75	66	58	67	80	91	104	100	104	176
L7 Hluti	53	71	65	65	62	69	70	62	70	81	75	88	158

L8 Excelsior	88	10	3	83	75	68	70	76	85	85	82	78	93 188
L9 Nkondolo	62	80	70	80	86	64	72	76	70	84	79	80	175
L10 Lismore	74	98	107	96	62	83	56	72	98	112	108	102	196
M8 Salitje	- 50	36	42	38	-	-	-	-	63	27	40		94
M10 Lavumisa	105	83	73	79	70	54	78	91	103	109	87	90	221

Inevitably, some grid units were more thoroughly covered than others. However, the coverage was far more uniform than that achieved in any other bird atlassing scheme in southern africa. Map 2 indicates those units which received significantly better coverage than others.



KEY: NUMBER OF FIELD CARDS



SWAZILAND

NUMBERS OF FIELD CARDS PER GRID UNIT

Map 2

Units with particularly good coverage generally coincide with population centres and public nature reserves. For these units a large number of field cards were submitted by observers other than the author.

Vetting

All field cards submitted by other observers were rigorously vetted by the author, in consultation with J. Culverwell and A. Robertson. Observers were requested to submit detailed accounts of any species considered to be unusual in the localities where they were recorded and these records were accepted or rejected on the basis of these accounts. In assessing such records, the policy adopted was that it was preferable to reject some good records than to accept some bad ones.

All records of species which are regarded as southern african rarities by the southern african rarities committee were submitted to that committee for ratification and were not included in this atlas unless accepted by the committee, with the exception of the only record for the honey buzzard (pernis apivorus) on which the committee had not yet reached a decision at the time of publication.

Interpretation

The level of coverage achieved is such that for most diurnal species, it can be assumed that the species is unlikely to have occurred (except as a vagrant) where it had not been recorded at all. However a few species whose calls are not well known in this region (especially migrant warblers such as the European Sedge Warbler, Garden Warbler and Whitethroat) may well be more widespread than their distribution maps indicate. Similarly some Accipiters (particularly Little Sparrowhawk and Little Banded Goshawk), which are both unobtrusive and usually silent, are probably more widespread and common than indicated.

The distributional data obtained for nocturnal species is regrettably fragmentary, and most nocturnal species can be assumed to be more widespread than the distribution maps indicate.

The following table shows the number of breeding species found in each region and the number of those which are not found in other regions.

TABLE 2 NUMBER OF BREEDING SPECIES IN EACH REGION

REGION:	HIGHVELD	MIDDLEVELD	W.LOWVELD	E.LOWVELD	LUBOMBOS
NO. BREEDING SPECIES	233	268	241	275	250
NO. EXCLUSIVE TO THE REGION	30	5	1	17	10

The following table gives the same information for species endemic to southern Africa.

TABLE 3 NUMBER OF SOUTHERN AFRICAN ENDEMICS BREEDING IN EACH REGION.

REGION:	HIGHVELD	MIDDLEVELD	W.LOWVELD	E.LOWVELD	LUBOMBOS
NO. BREEDING SPECIES:	28	13	7	6	10
NO. EXCLUSIVE TO THE REGION:	15	0	1	0	0

A total of three southern African endemics (namely southern black tit, southern boubou and Cape white-eye) breed in all the regions of Swaziland.

THE DROUGHT OF 1992

After termination of the data collection for the bird atlas, during the period January to July 1992, unusual movement patterns were noted for some bird species, presumably in response to the unusually severed drought conditions which prevailed throughout Swaziland. These movements have not been recorded on the distribution maps, but have been described under the species accounts for the species concerned.

ANALYSIS OF ESTIMATED POPULATION SIZES

The following table indicates how many bird species which breed within Swaziland have estimated populations falling within each of 9 population size categories. The large number of species with relatively small estimated populations can be largely attributed to the fact that each natural habitat type within Swaziland is restricted to a fairly small area.

An account of how the population estimates were arrived at can be found under "EXPLANATION OF SPECIES ACCOUNTS" below.

TABLE 4: Population sizes.

ESTIMATED POPULATION	NUMBER OF SPECIES
0-49	66
50-99	15
100-499	88
500-999	24
1 000-4 999	89
5 000-9 999	26
10 000-49 999	46
50 000-99 999	11
100 000 and over	16

SPECIES DISTRIBUTION BOUNDARIES WHICH COINCIDE WITH POLITICAL BOUNDARIES

Comparison of the species distribution maps with corresponding maps for the Transvaal (Tarboton, Kemp & Kemp) and Natal (Cyrus and Robson) shows that a considerable number of species boundaries coincide with the political boundaries of Swaziland, especially with the western boundary with the Transvaal.

The political boundaries of Swaziland in fact correspond for most of their length with physical features which are not always obvious. The western boundary in particular mostly follows a ridge which in places is steep and obvious and in others barely discernible. On the Swaziland side of this boundary, the terrain is more broken and consequently more wooded by comparison with the uninterrupted grassland on the Transvaal side. In respect of all the boundaries, the corresponding natural differences in habitat on either side of the boundaries appears to be sufficient to account for the above mentioned phenomenon.

The species whose distribution boundaries coincide sharply with political boundaries are listed below. Species which are likely to have been largely overlooked on either side of the boundary are not included. Species whose distribution boundaries may coincide with the eastern boundary are not considered due to lack of information about species distributions in southern Mocambique.

In addition to those listed, a number of species boundaries coincide somewhat less sharply with the political boundaries.

TABLE 5: SPECIES WHOSE DISTRIBUTION BOUNDARIES COINCIDE WITH POLITICAL BOUNDARIES.

A: NORTHERN BOUNDARY: SPECIES OCCURRING IN THE TRANSVAAL AND NOT IN SWAZILAND: (3 species)

353 Mourning dove (Streptopelia decipiens)
756 Whitecrowned shrike (Eurocephalus anguitimens)
765 Greater blue-eared starling (Lamprotornis chalybaeus)

B: NORTHERN BOUNDARY: SPECIES OCCURRING IN SWAZILAND AND NOT IN THE TRANSVAAL: (1 species)

469 Redfronted tinkerbarbet (Pogoniulus pusillus)

C: WESTERN BOUNDARY: SPECIES OCCURRING IN THE TRANSVAAL AND NOT IN SWAZILAND: (12 species)

234 Blue korhaan (Eupodotis caenulescens)
495 Clapper lark (Mirafra apiata)
506 Spikeheeled lark (Chersomanes albofasciata)
523 Pearlbreasted swallow (Hirundo dimidiata)
528 South African cliff swallow (Hinundo spilodera)
579 Orange Thrush (Turdus gurney)
639 Barratt's warbler (Bradypterus barratti)
685 Blackchested prinia (Prinia flavicans)
721 Rock pipit (Anthus crenatus)
758 Indian mynah (Acridotheres tristis)
856 Blackthroated canary (Serinus atrogularis)

D: WESTERN BOUNDARY: SPECIES OCCURRING IN SWAZILAND AND NOT IN ADJOINING PARTS OF THE TRANSVAAL: (31 species)

358 Greenspotted dove (Turtur chalcospilus)
359 Tambourine dove (Turtur tympanistria)
361 Green pigeon (Treron calva)
371 Purplecrested lourie (Tauraco porphyreolophus)
384 Emerald cuckoo (Chrysococcyx cupreus)
427 Narina trogon (Apaloderma narina)
432 Pygmy kingfisher (Ispidina picta)
438 European bee-eater (Merops apiaster)
454 Scimitarbilled Woodhoopoe (Phoeniculus cyanomelas)
455 Trumpeter hornbill (Bycanistes bucinator)
460 Crowned hornbill (Tockus alboterminatus)
475 Scalythroated honeyguide (Indicator variegatus)
483 Goldentailed woodpecker (Campethera abingoni)
521 Blue swallow (Hirundo atrocaenulea)
522 Wiretailed swallow (Hirundo smithii)
549 Grey cuckooshrike (Coracina caesia)
560 Arrowmarked babbler (Turdoides jardineii)
572 Sombre bulbul (Andropadus importunus)
600 Natal robin (Cossypha natalensis)
613 Whitebrowed robin (Erythropygia leucophrys)

642 Broadtailed warbler (Schoenicola brevirostris)
648 Yellowbreasted apalis (Apalis flavida)
651 Longbilled crombec (Sylvietta rufescens)
657 Bleating warbler (Camaroptera brachyura)
672 Rattling cisticola (Cisticola chiniana)
674 Redfaced cisticola (Cisticola erythrops)
691 Bluegrey flycatcher (Muscicapa caerulescens)
742 Southern tchagra (Tchagra tchagra)
748 Orangebreasted Bush Shrike (Telophorous sulfureopectus)
810 Spectacled weaver (Ploceus ocularis)
877 Bully canary (Serinus sulphuratus)

E: SOUTHERN BOUNDARY: SPECIES OCCURRING IN NATAL AND NOT IN SWAZILAND: (6 species)

387 Green coucal (Ceuthmochares aereus)
407 Natal nightjar (Caprimulgus natalensis)
675 Blackbacked cisticola (Cisticola galactotes)
797 Yellow white-eye (Zosterops senegalensis)
818 Brownthroated weaver (Ploceus xanthopterus)
822 Redheaded quelea (Quelea erythrops)

F: SOUTHERN BOUNDARY: SPECIES OCCURRING IN SWAZILAND AND NOT IN NATAL: (2 SPECIES)

481 Bennett's woodpecker (Campethera bennettii)
762 Burchell's starling (Lamprotornis australis)

COMPARISON OF ATLAS DATA WITH THE SAOS CHECKLIST

The following species are listed in the SAOS Checklist of Southern African Birds (Clancey) as occurring in Swaziland but for which no confirmed records of sightings within Swaziland exist. The inclusion of Swaziland in the supposed range of these species was speculative in most cases and was down without detailed knowledge of the topography and vegetation of the country. It is therefore not certain that all of these species ever did occur in Swaziland. However it is likely that at least some of these species used to occur in Swaziland and have become locally extinct due to habitat changes caused by human activity.

SAOS CHECKLIST SPECIES NOT RECORDED IN THE ATLAS

Ayres Eagle (Hieraaetus ayresii), African Hobby (Falco cuvierii), Greater Kestrel (Falco rupicoloides), Greywing Francolin (Francolinus africanus), Blue Quail (Coturnix adansonii), Wattled Crane (Grus carunculatus), Blue Korhaan (Eupodotis caerulescens), Burchell's Courser (Cursorius rufus), Blackwinged Pratincole (Glareola nordmanni), Brownnecked Parrot (Poicephalus robustus), Green Coucal (Ceuthmochares aereus), Cape Eagle Owl (Bubo capensis), Racquettailed Roller (Coracias spatulata), Rudd's Lark (Heteromirafra ruddi), Pinkbilled Lark (Calandrella conirostris), Pearlbreasted Swallow (Hirundo dimidiata), Cliff Swallow (Hirundo spilodera), Shorttoed Rock Thrush (Monticola brevipes), Barratt's Warbler (Bradypterus barratti), Palecrowned Cloud Cisticola (Cisticola brunnescens), Rock Pipit (Anthus crenatus), Tree Pipit (Anthus trivialis), Yellowbreasted Pipit (Anthus chloris), Whitecrowned Shrike (Eurocephalus anguitimens), Greater Blue-eared Starling (Lamprotornis chalybaeus), Great Sparrow (Passer Motitensis), Cutthroat Finch (Amadina fasciata), Pied Mannikin (Spermestes fringilloides) and Purple Widowfinch (Vidua purpurascens).

Of the above, the following are considered most likely to have occurred in Swaziland in the past and may possibly still occur, at least as vagrants: African Hobby (Falco cuvierii), Blue Quail (Coturnix adansonii), Wattled Crane (Grus carunculatus), Blackwinged pratincole (Glareola nordmanni), Cape eagle owl (Bubo capensis), Tree Pipit (Anthus trivialis) and Purple Widowfinch (Vidua purpurescans).

CONSERVATION STATUS

The following species have been listed in the "Swaziland Red Data Book: Birds" (Parker, V. in prep) as being of conservation importance. The categories referred to are:

TABLE 6: CONSERVATION STATUS

	Category		Category
Whitebacked night heron	4	African finfoot	2
Dwarf bittern	4	Kornbustard	1
Black stork	3	Stanley's bustard	2
Saddlebilled stork	2	Lesser blackwingedplover	3
Yellowbilled stork	3	Temminck's courser	4
Marabou stork	2	Bronzewinged courser	4
Secretary bird	2	Redwinged pratincole	4
Cape vulture	1	Greatspotted cuckoo	4
Lappetfaced vulture	2	Black coucal	2
Whiteheaded vulture	2	Grass owl	2
Cuckoo hawk	3	Barred owl	3
Black eagle	3	Giant eagle owl	4
Tawny eagle	2	Pel's fishing owl	1
African hawk eagle	2	Broadbilled roller	4
Longcrested eagle	3	Ground hornbill	2
Martial eagle	2	African broadbill	3
Crowned eagle	3	Blue swallow	2
Blackbreasted snake eagle	2	Bush blackcap	3
Bateleur	2	Yellowstreaked bulbul	4
Redbreasted sparrowhawk	3	Sentinel rock thrush	4
Gabar goshawk	3	Mountain chat	3
Peregrine falcon	4	Brown robin	4
Blackrumped buttonquail	2	Broadtailed warbler	5
Blue crane	3	Buffy pipit	3
Crowned crane	2	Southern tchagra	4
African crake	3	Grey sunbird	4
Striped flufftail	2	Pinkthroated twinspot	5

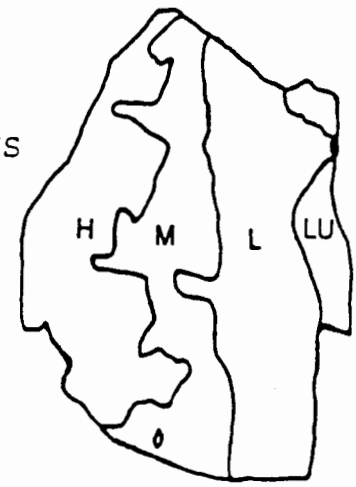
Of these, 11 species inhabit wetlands, 15 grassland, 15 savanna and 13 woodland and forest.

TOPOGRAPHY AND VEGETATION

The five topographical regions of Swaziland are as defined in Map 3.

SWAZILAND

MAJOR TOPOGRAPHIC REGIONS



H = Highveld
M = Middleveld
L = Lowveld
LU = Lubombos

Map 3

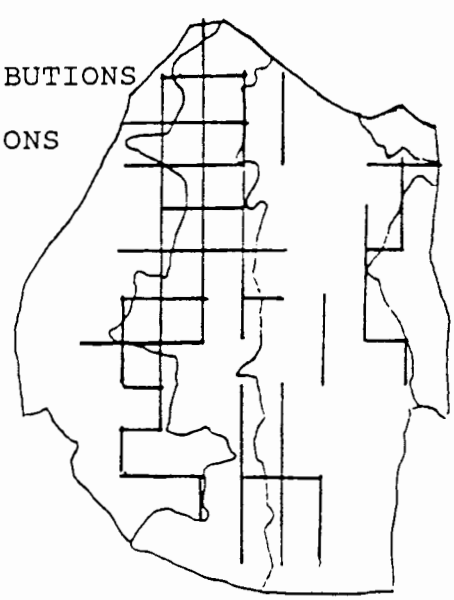
The boundaries of the topographic regions follow the 1000 and 500 m altitude contours. It was found that the distribution boundaries for a large number of bird species coincide remarkably closely with these boundaries. (By comparison there is a much poorer correlation between the species distribution maps and Acocks classification of veld types).

Map 4 illustrates the close relationship between the boundaries of the topographical regions and the species distribution boundaries. Lines were drawn wherever the distribution boundaries (defined by 1/8 degree grid lines)) of 10 or more species coincided. These are superimposed on the map showing the boundaries of the topographical regions.

SWAZILAND

BOUNDARIES OF SPECIES DISTRIBUTIONS

COMPARED TO TOPOGRAPHIC REGIONS



Map 4

In describing the distribution patterns for several species, it was found to be convenient to subdivide the lowveld region into the eastern lowveld and western lowveld sub regions. The distinction between the two sub regions is described below.

Whereas in the north of Swaziland the boundaries between the topographical regions are sharply defined both in terms of relief and vegetation types, in the south the boundaries are less well defined and, in particular, the highveld and middleveld regions tend to merge into each other.

A description of the vegetation types within each topographical region follows:

HIGHVELD:

(Altitude above 1000 m). The highveld of Swaziland forms part of the Drakensberg escarpment of South Africa and is a mountainous region, varying from steep rugged terrain to undulating slopes. The natural vegetation consists of small pockets of Afromontane forest on the steeper slopes, scrubby woodland on intermediate slopes and extensive grassland and vleis on the gentler slopes, interspersed with rocky outcrops which are covered with bushes and small trees.

HUMAN MODIFICATION:

Much of the highveld grasslands have been replaced by commercial pine and eucalypt plantations. Overgrazing by livestock is widespread and has led to a reduced density of grass cover, formation of erosion gullies, and depletion and disappearance of vleis. Encroachment of maize cultivation around their edges has also contributed to the demise of the vleis. Wattle trees have spread rapidly since being introduced and dense stands now cover a large proportion of the highveld and are still spreading, despite heavy utilization for fuel and timber. The availability of wattle has to a large extent protected the natural forests from destruction. However, indigenous forest trees are specifically sought out for some purposes and most of the natural forests have been depleted to some extent.

MIDDLEVELD:

(Altitude 500-1000m). The middleveld is a transitional zone between the highveld and western lowveld and consists largely of rolling topography, some mountainous areas and several large river valleys. The vegetation consists of broadleaved savanna, woodland and forest. A particularly extensive forested area occurs in the Mlumati Valley in the north west. The forest type is distinct both from the Afromontane forests of the highveld and from the coastal forest type of the Lubombos.

HUMAN MODIFICATION:

Much of the natural vegetation has been replaced by cultivation, and overgrazing by livestock has been particularly severe in this region, causing spectacular erosion gullies in some areas.

WESTERN LOWVELD:

(Altitude 250-500m). This region consists of gently rolling country with a few isolated hills and has sandy soils. The natural vegetation consists of patches of Acacia savanna interspersed with broadleaved (Combretum and Terminalia) woodland.

HUMAN MODIFICATION:

Some of the natural vegetation has been replaced by cultivation. Overgrazing has resulted in

scanty grass cover and soil erosion in some areas. In the more densely populated areas tree cover has been much reduced through exploitation for fuel and timber.

EASTERN LOWVELD:

(Altitude 250-500m). This is a flat region with clayey soils. The natural vegetation consists predominantly of knobthorn-marula savanna, with ribbons of forest and woodland along the river banks.

HUMAN MODIFICATION:

Much of the natural vegetation has been removed for the cultivation of sugar, cotton and citrus. Overgrazing has led to severe bush encroachment (mostly of Dichrostachys cinerea), transforming much of the original savanna into a shrubby woodland. In this respect, special mention must be made of Hlane National Park in the northeast of Swaziland. In an area of about 15 000 ha with no natural predators, the wild ungulate population has been allowed to increase unchecked. The resulting overgrazing has led to an extreme case of bush encroachment, with the original savanna transformed into an almost continuous thorn thicket, and with large areas devoid of grass cover. Some savanna-loving bird species (e.g. Longtailed Shrike, Redbilled Hornbill and Bennetts Woodpecker) and some grass loving species (e.g. Whitewinged Widow and Rufousnaped Lark) are predictably absent from Hlane, though occurring in the immediately surrounding area. However, some woodland species, which are common in the surrounding area, are also largely absent from Hlane, notably the Speckled Mousebird and Cape White-eye.

THE LUBOMBOS:

(Altitude: 250-780m). This region consists of a low rhyolitic mountain range. The natural vegetation consists of Acacia savanna on the western slopes, broadleaved savanna on the plateau, and forests in the gorges and on other steep slopes. These forests are largely of the Indian Ocean coastal belt forest type, but include some highveld tree species. On some drier slopes in the eastern gorges, large monospecific Androstachys johnsonii forests occur.

HUMAN MODIFICATION:

Some cultivation occurs on the plateau and many of the forests have been much depleted for fuel and timber.

EXPLANATION OF SPECIES ACCOUNT

NAMES AND NUMBERS:

The species number, English name and scientific name given for each species are those used in Roberts' Birds of Southern Africa by Gordon Lindsay Maclean (1985).

RECORDING FREQUENCY:

The recording frequency quoted for each species is the number of field cards on which the species was recorded (out of a total of 2263 field cards).

POPULATION ESTIMATE:

For each species which is believed to breed within Swaziland, an estimate of the total number of breeding adults within Swaziland is given. The estimates are based on rough estimates of the density of breeding pairs of each species in suitable habitat together with estimates of the total

area of such habitat available. Adults which breed outside of Swaziland and occur in Swaziland when not breeding are excluded from the estimates. Densities for a few species were obtained by direct censussing and for others published density estimates for the same species in another region (Koen & Crowe; Tarboton & Allan; Tarboton, Kemp & Kemp) were used. For many species, estimates were obtained by comparing recording frequencies with those of similarly conspicuous species whose densities had already been estimated.

The population estimates are conservative, and actual numbers for each species are more likely to be higher than the estimate than lower. Whereas some of the estimates could well be out by a factor of two, they are unlikely to be out by as much as a factor of ten.

For a few species (Marabou Stork, Blue Swallow and Fish Eagle) the total populations were carefully censussed and these estimates are given with far more confidence than the rest.

It should be stressed that the population estimates refer specifically to the atlas period and that for some species the populations may vary very greatly in subsequent years.

STATUS:

The relative abundance and seasonality are commented on and whether or not the species is suspected to or known to breed within Swaziland. The details of breeding records accumulated in Swaziland during the atlas period will be summarised in the SABAP atlas.

HABITAT PREFERENCE:

The habitat preference listed for each species refers specifically to the habitat types in which the species was most frequently encountered within Swaziland and may differ in some cases with the habitat preference for the same species in other regions.

SPECIES DISTRIBUTION MAPS

The species distribution maps are of two types (by month or by recording rate).

DISTRIBUTION MAPS BY MONTH

This type of map is used to represent the distributions of those species which are subject to seasonal movements. The circle in each grid is divided into 12 segments representing the months of the year, from January at one o'clock clockwise to December twelve o'clock. Only those segments corresponding to the months of the year during which the species was recorded within that grid unit are blacked in.

DISTRIBUTION MAPS BY RECORDING RATE

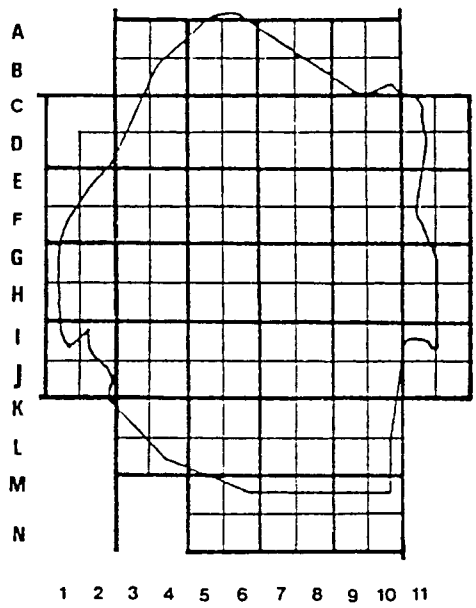
This type of map is used to represent the distributions of species whose distribution patterns reveal no evidence of seasonal movement. For these species, a circle is placed within each grid unit in which the species was recorded and the radius of the circle is proportional to the recording rate of the species within that grid unit.

The recording rate used here is the percentage of months of the year in which the species was recorded within the grid unit rather than the percentage of field cards for the grid unit on which the species was recorded.

The latter and more conventional definition of recording rate was rejected because in terms of this definition many species showed significantly lower recording rates for those grid units for which there were a large number of field cards because many of such field cards had relatively low species totals. The alternative recording rate calculation eliminates this bias. For the majority of

grid units, where the number of field cards per month seldom exceeds one, the difference between the two recording rate calculations is little or none.

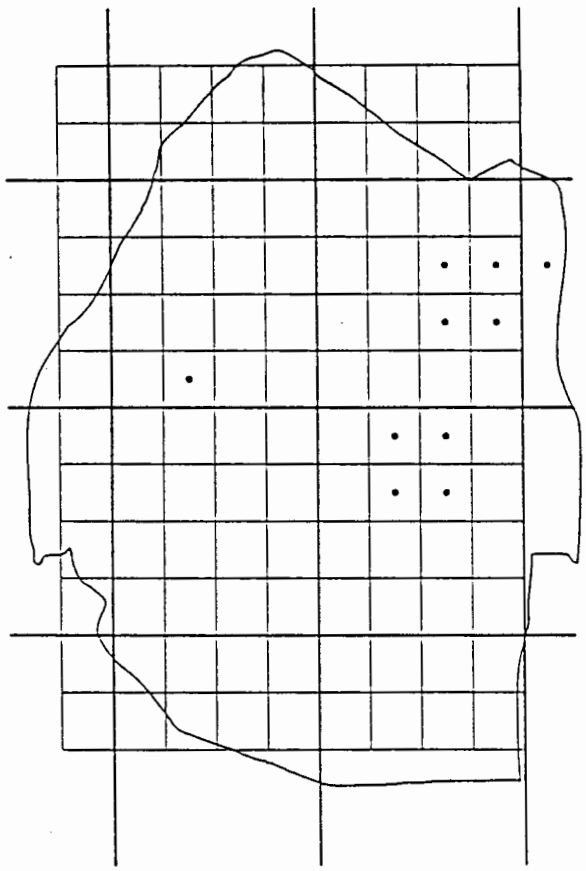
KEY TO GRID UNIT NAMES

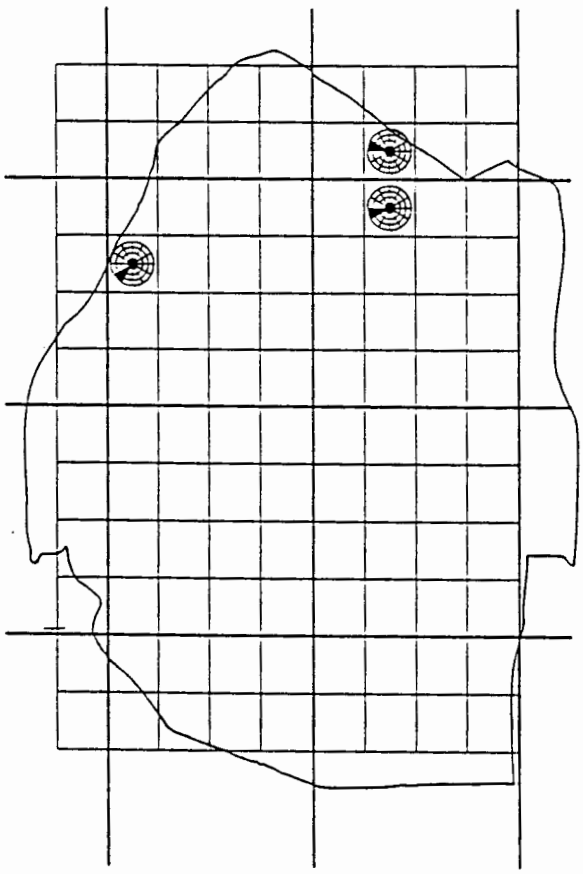


SPECIES ACCOUNTS

1. Ostrich. (Struthio camelus)

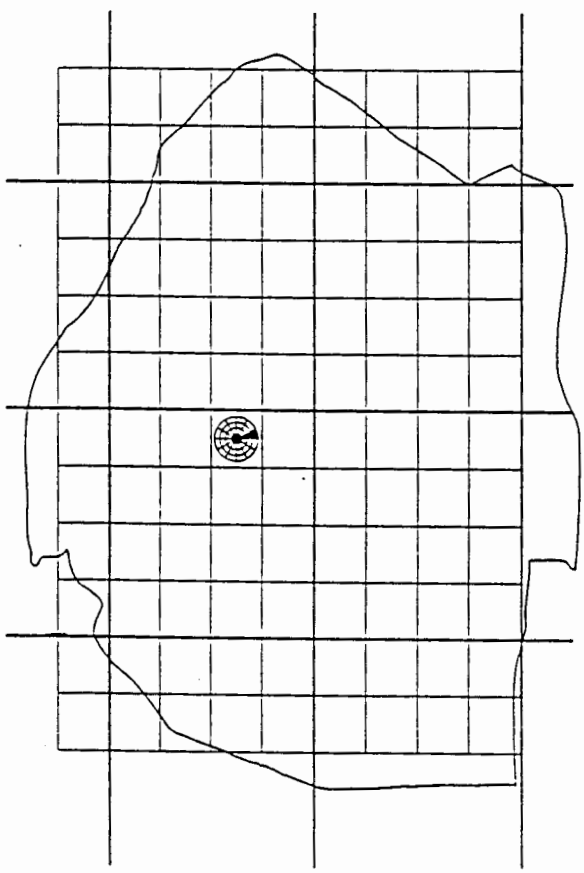
Not all distribution records of this species have been mapped due to uncertainty about which birds are truly feral. At present, the species occurs in the Mlilwane (F4), Mkhaya (G8, G9, H8, H9), Hlane (D9, E9, E10) and Mlawula Nature Reserves (D10, D11). All the birds presently in Swaziland are descendants of domesticated birds introduced from South Africa. Ostriches are known to have occurred at Mhlosheni (L6) in the far south of Swaziland during the 1940s (J.Fourie pers. comm.). It is not known whether these birds were of wild stock or escaped domesticated birds.
It is believed that wild birds did not occur elsewhere in Swaziland during this century before their introduction to nature reserves in the 1960s (R. Harding, D. Forbes, P. Forsyth-Thompson, R. Girdwood pers. comm.). However, Ostrich egg shell fragments have been recovered from several archaeological sites in Swaziland and it is believed that the wild Ostrich population was hunted to local extinction early in the 19th century. (J. Masson, pers. comm.).





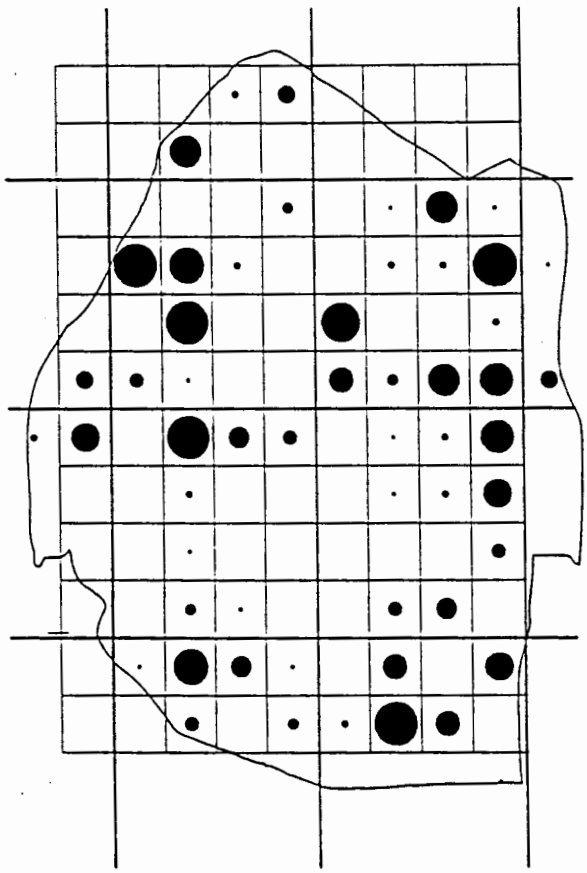
6. Greatcrested grebe. (Podiceps cristatus)

Recording frequency: 3 (/2263) 0,15%.
Status: A rare vagrant to Swaziland.
Habitat preference: Large dams.



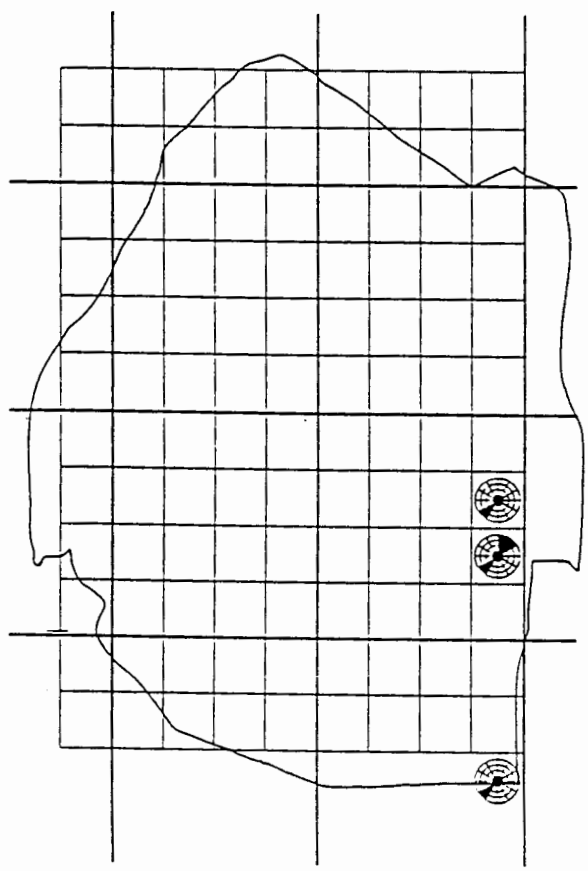
7. Blacknecked grebe. (Podiceps nigricollis)

Recording frequency: 1 (/2263) 0,05%.
Status: The species has only been recorded once in Swaziland. A group of five birds was seen on a settling pan at Matsapha (G5) in March 1987 (VP).



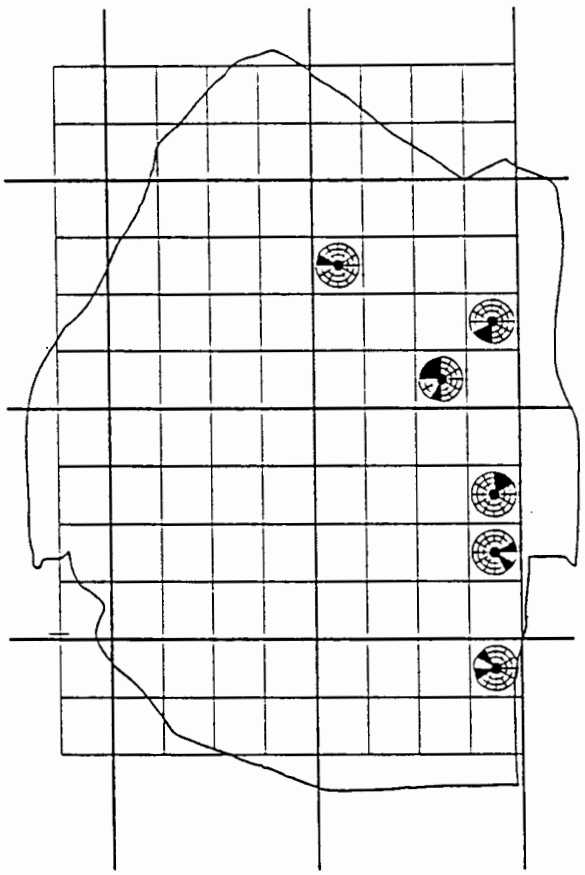
8. Dabchick. (Tachybaptus ruficollis)

Recording frequency: 438 (/2263) 19%.
Population estimate: 400
Status: A common breeding resident.
Habitat preference: Likely to be found on any still open waters. In the lowveld it is seldom seen on the large dams, though very common on small dams and ponds. In the highveld however it is numerous on the large Hawane dam as well as occurring on most smaller waters.



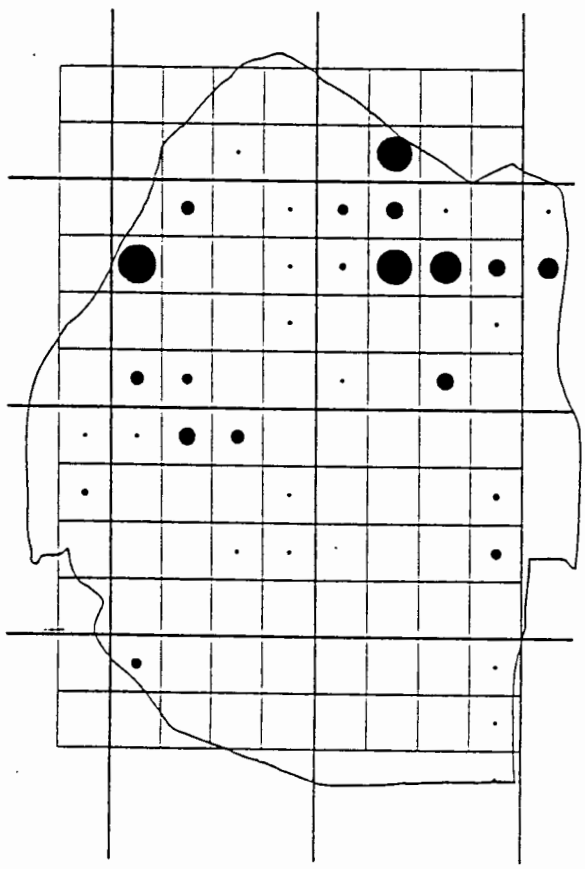
49. White pelican. (Pelecanus onocrotalus)

Recording frequency: 6 (/2263) 0,3%.
Status: A rare vagrant. During August 1986 a flock of 50 birds was seen flying northwards from Jozini Dam (M10) in the extreme south east of Swaziland. During subsequent weeks smaller groups were seen on various dams in the vicinity of Big Bend (I10). Outside of that period, only two other sightings of the species have been reported.



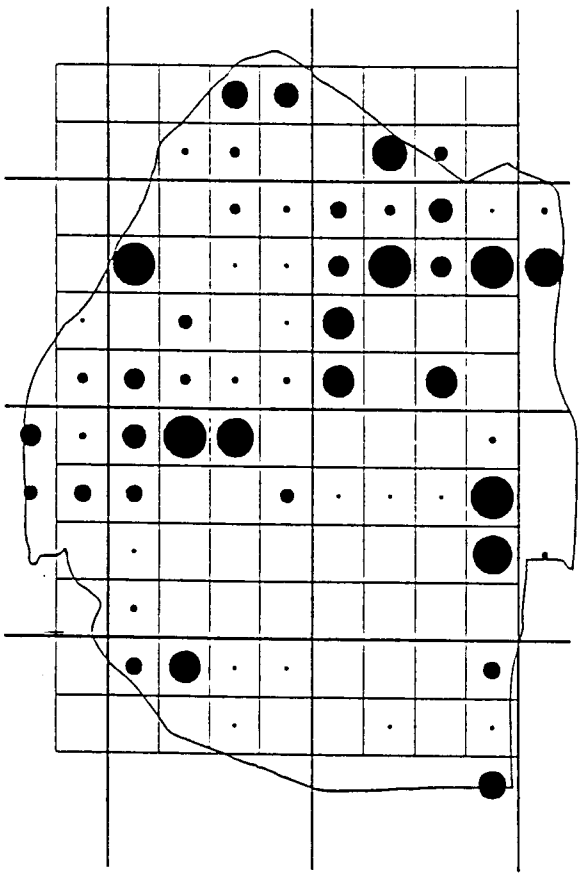
50. Pinkbacked pelican. (Pelecanus rufescens)

Recording frequency: 13 (/2263) 1%.
Status: Uncommon visitor. The species bred on Jozini Dam on the Swaziland border (M10) in 1986 (Tarboton, Kemp & Kemp), but has not subsequently bred at that site. Breeding elsewhere in Swaziland is possible but has not been observed.
Habitat preference: Larger dams in the lowveld.



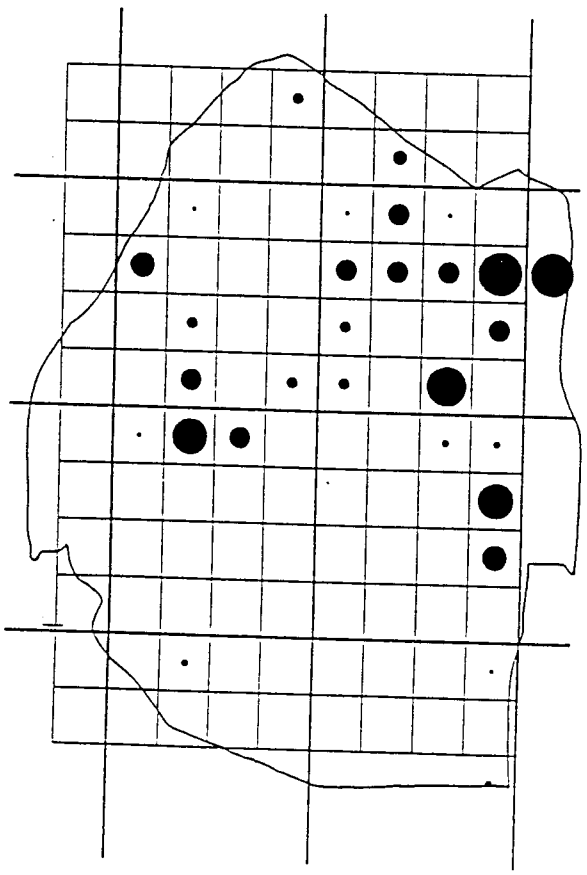
55. Whitebreasted cormorant. (Phalacrocorax carbo)

Recording frequency: 139 (/2263) 6%.
Population estimate: 40.
Status: Uncommon breeding resident. Usually encountered in pairs but sometimes congregate in groups of up to 20 on the large dams.
Habitat preference: Found on large dams and along the larger rivers in all regions.



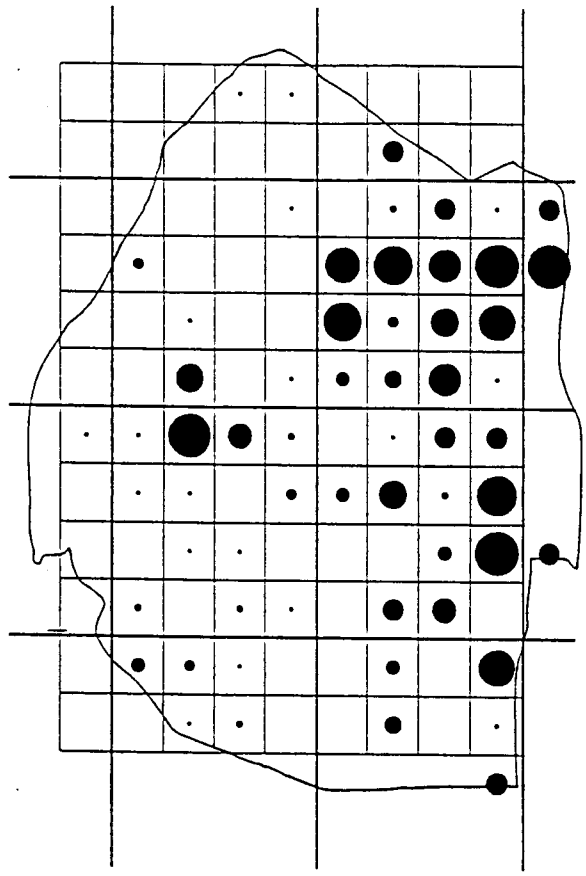
58. Reed cormorant. (Phalacrocorax africanus)

Recording frequency: 507 (/2263) 22%.
Population estimate: 500.
Status: Common breeding resident. Gathers in flocks of up to 100 birds at communal roosts.
Habitat preference: Dams and rivers in all regions.



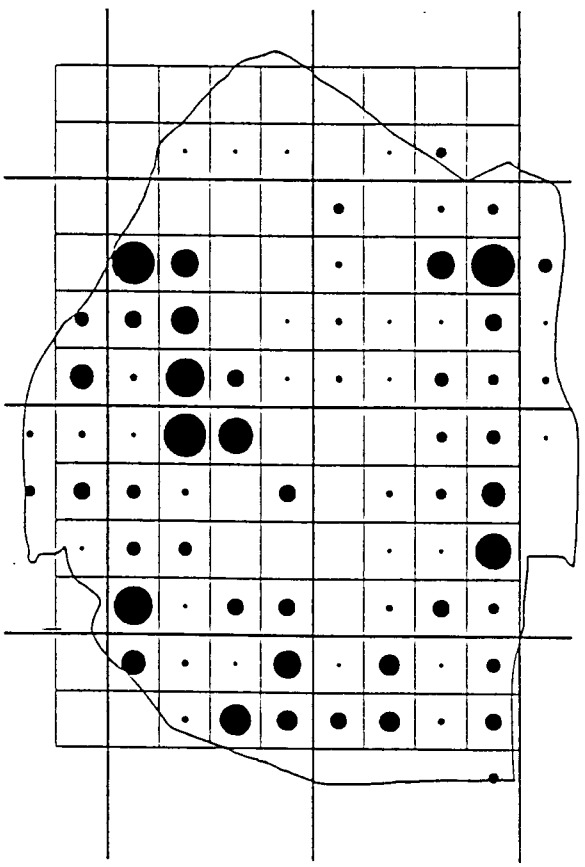
60. Darter. (Anhinga melanogaster)

Recording frequency: 210 (/2263) 9%.
Population estimate: 40.
Status: Uncommon breeding resident. Usually solitary but sometimes gathers in groups of up to 10 on the large lowveld dams.
Habitat preference: Occurs in all regions. Found on dams with deep water and occasionally on large rivers.



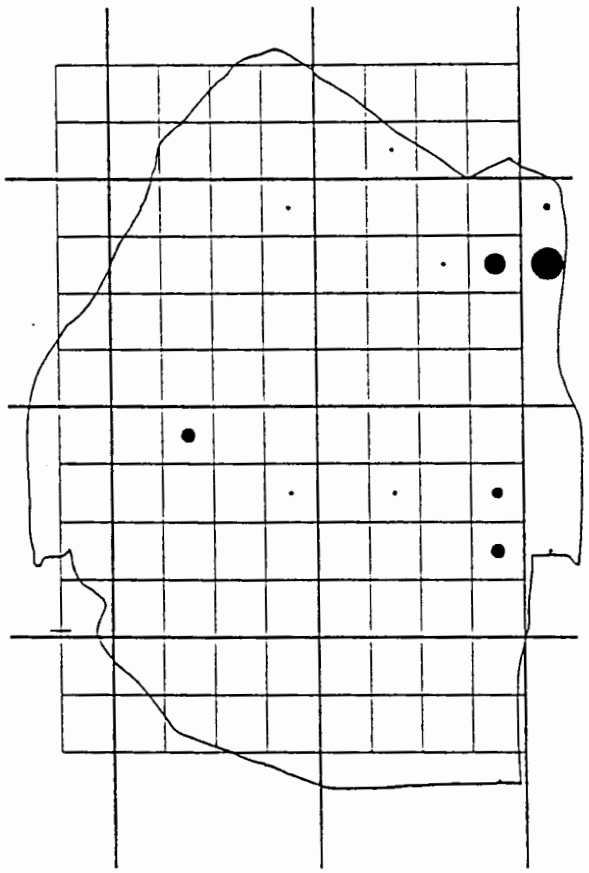
62. Grey heron. (Ardea cinerea)

Recording frequency: 466 (/2263) 21%.
Population estimate: 200.
Status: A common breeding resident in the lowveld and middleveld and a rare visitor to the highveld. Usually encountered singly. Breeds communally in colonies of 4 or 5 nests at 2 sites in the Umbuluzi Gorge (D11), but nests are solitary elsewhere.
Habitat preference: Dams and rivers.



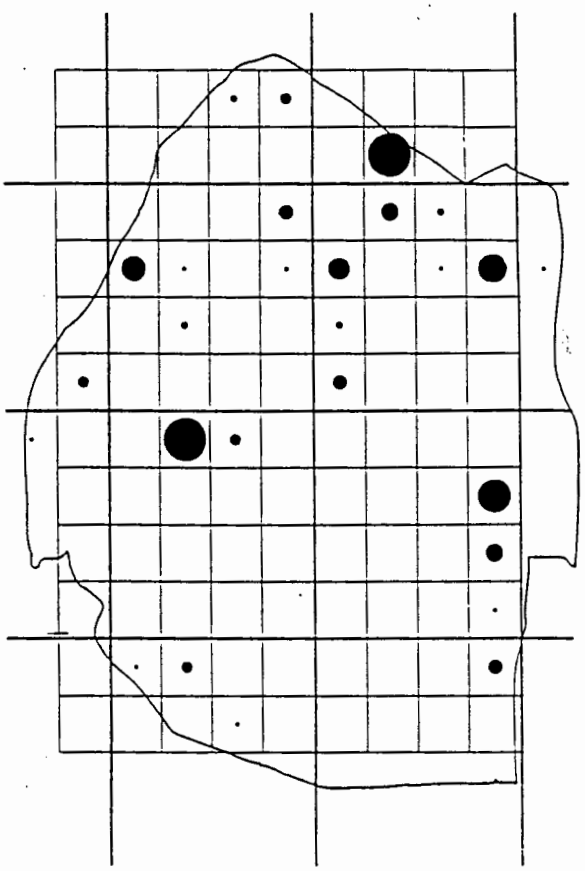
63. Blackheaded heron. (Ardea melanocephala)

Recording frequency: 512 (/2263) 23%.
Population estimate: 500.
Status: A common breeding resident. Congregates in flocks of up to 20 birds at abundant food sources but solitary at other times. Breeds communally, with up to 20 nests in a colony, often in association with cattle egrets.
Habitat preference: Vleis, grassland and cultivated lands.



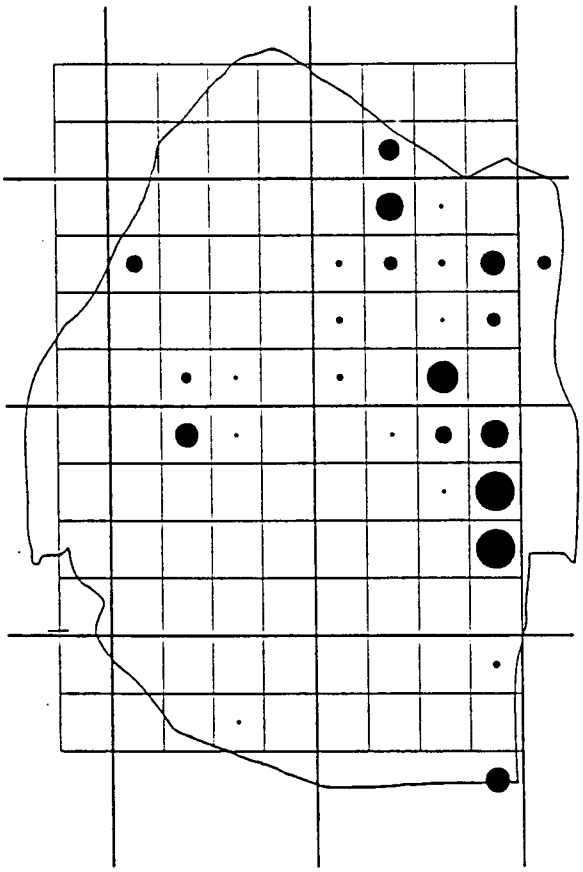
64. Goliath heron. (Ardea goliath)

Recording frequency: 39 (/2263) 2%.
Population estimate: 10.
Status: An uncommon breeding resident in the lowveld and occasional visitor to the middleveld. Encountered singly or in pairs.
Habitat preference: Dams and large rivers.



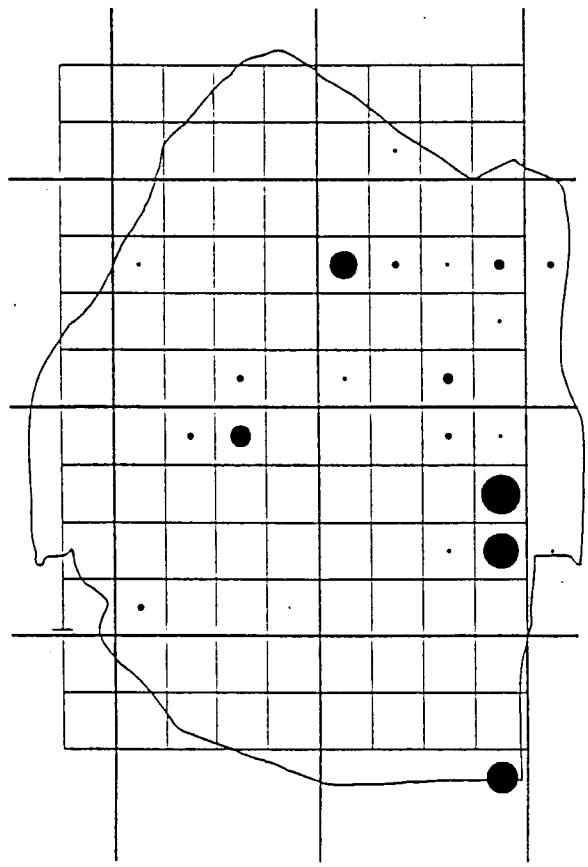
65. Purple heron. (Ardea purpurea)

Recording frequency: 148 (/2263) 7%.
Population estimate: 200.
Status: An uncommon breeding resident in all regions. Has been encountered in groups of up to 10 birds at the Sand River Dam (B8), but singly elsewhere.
Habitat preference: Reedbeds associated with dams.



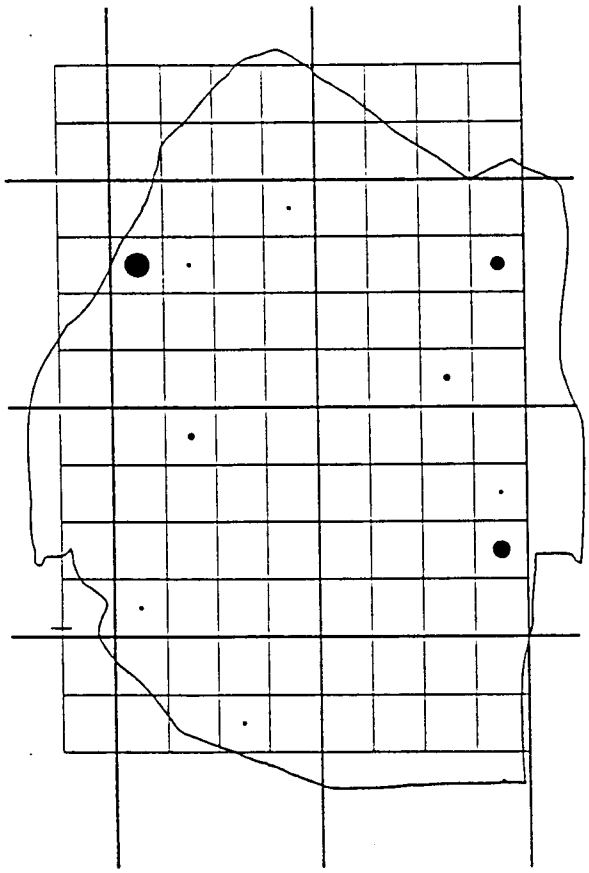
66. Great white egret. (Egretta alba)

Recording frequency: 156 (/2263) 7%.
Population estimate: 24.
Status:An uncommon resident (probably breeding) in the lowveld and uncommon visitor to the middleveld and highveld. Encountered singly or in pairs.
Habitat preference: Dams and rivers.



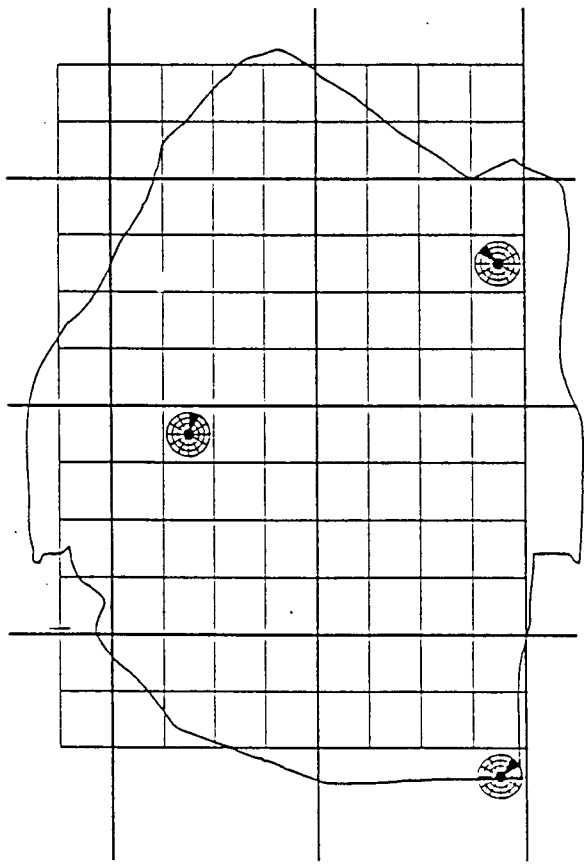
67. Little egret. (Egretta garzetta)

Recording frequency: 84 (/2263) 4%.
Population estimate: 10.
Status: Uncommon resident (probably breeding) in the lowveld and middleveld and a vagrant in the highveld. Encountered singly or in pairs.
Habitat preference: Rivers and dams.



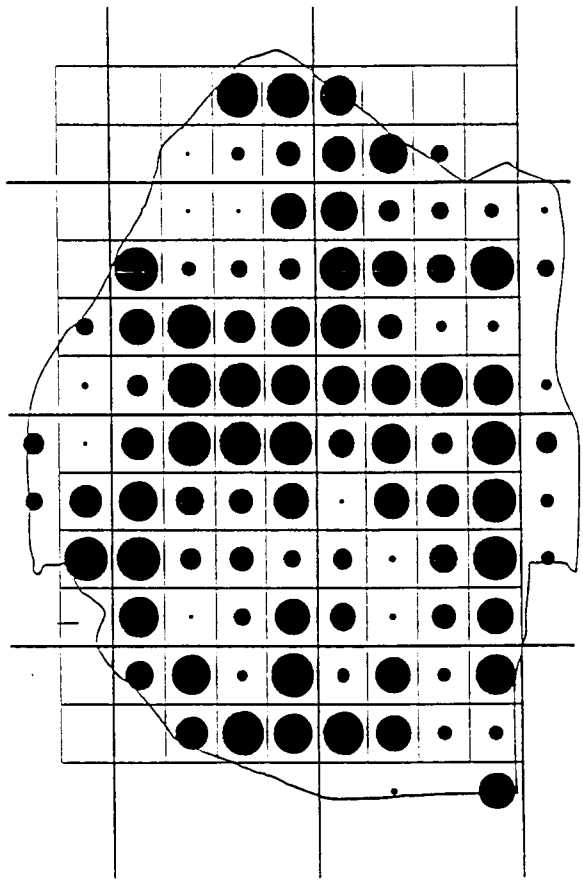
68. Yellowbilled egret. (Egretta intermedia)

Recording frequency: 29 (/2263) 1%.
Status: It is not clear whether the species is an uncommon visitor or a rare breeding resident, occurring in all regions. Encountered in ones and twos.
Habitat preference: Dams and vleis.



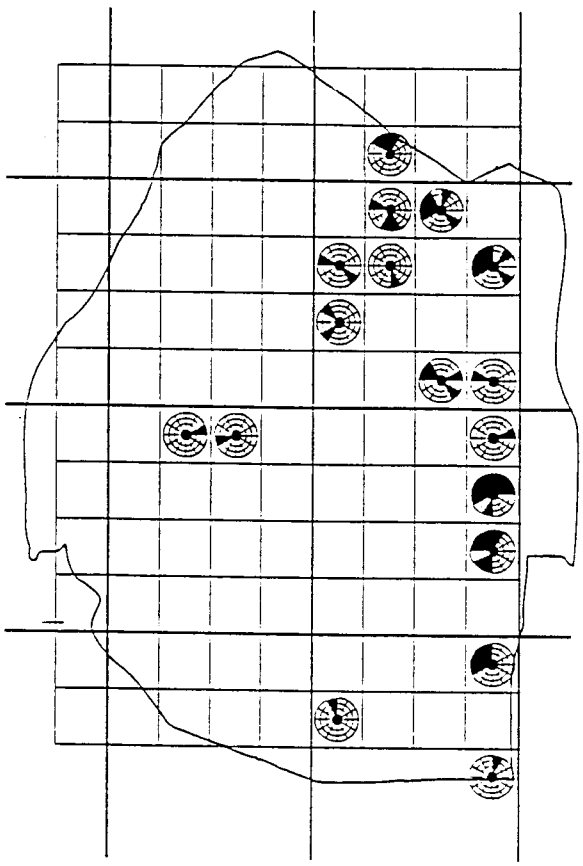
69. Black egret. (Egretta ardesiaca)

Recording frequency: 3 (/2263) 0,15%.
Status: Rare vagrant. One was seen at the settling ponds at Simunye (D10) in November 1987 (T. & P. Sandiford), one at a small dam at Malkerns (G4) in January 1989 (D. James) and two at the Jozini Dam (M10) in February 1991 (VP). The species is known to have occurred at Ricelands (B9) near Tshaneni prior to 1980 (J. Culverwell) but has not been seen there since rice cultivation was discontinued.
Habitat preference: Dams.



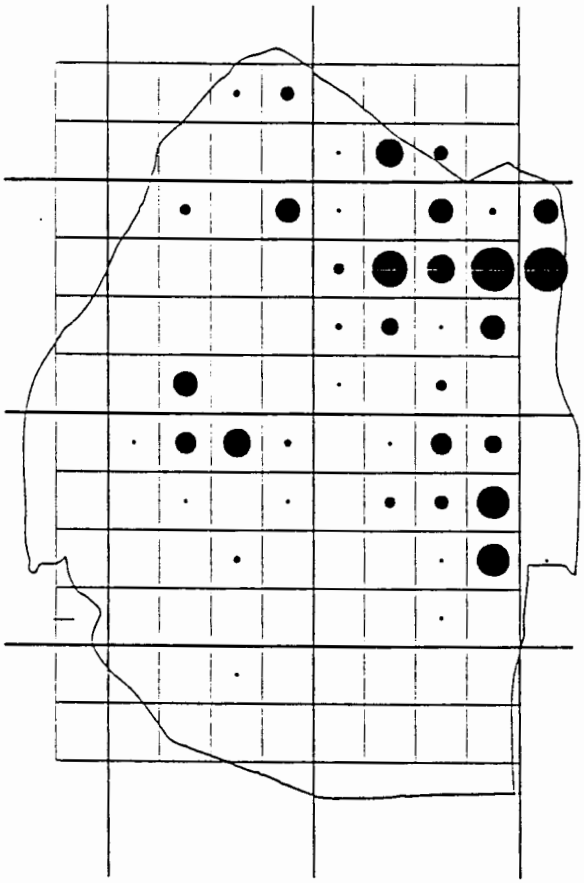
71. Cattle egret. (Bubulcus ibis)

Recording frequency: 1 264 (/2263) 56%.
Population estimate: 10 000.
Status:A very common resident in all regions. Several small and medium sized breeding colonies are known in the middleveld (e.g. Magadusa, Mlilwane, Mankayane and Paradys) and one colony at Mafutseni (F7) at the edge of the lowveld usually contains a thousand or more nests. The birds travel considerable distances each day in order to return to a few communal roosts, usually distinct from the breeding sites. Within Swaziland the species is not subject to the seasonal movements which have been observed in the Transvaal.
Habitat preference: Forages wherever cattle graze. Communal roosts are usually at the waterside and breeding colonies are situated in reedbeds or large trees.



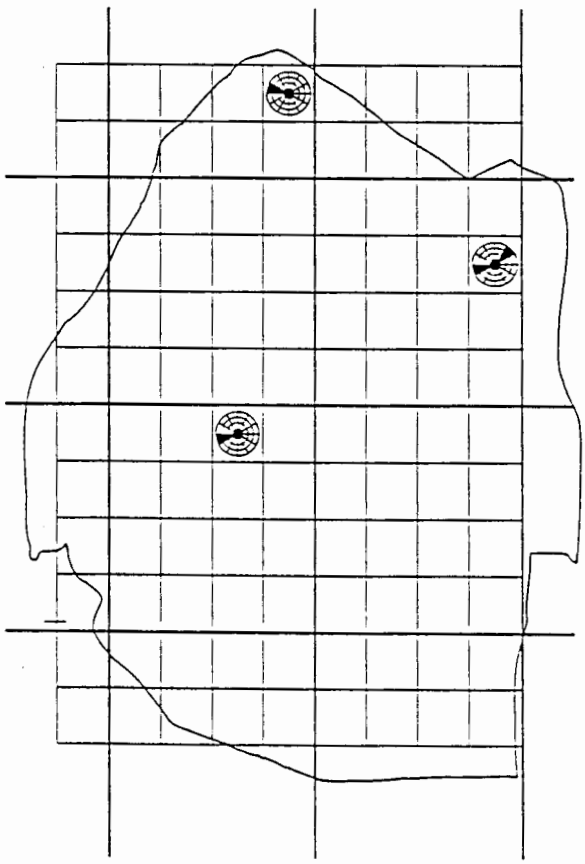
72. Squacco heron. (Ardeola ralloides)

Recording frequency: 69 (/2263) 3%.
Population estimate: 10.
Status: An uncommon summer visitor (probably breeding) in the lowveld, with immature birds occasionally overwintering and vagrant in the middleveld.
Habitat preference: Dams with extensive reedbeds or flooded grasses.



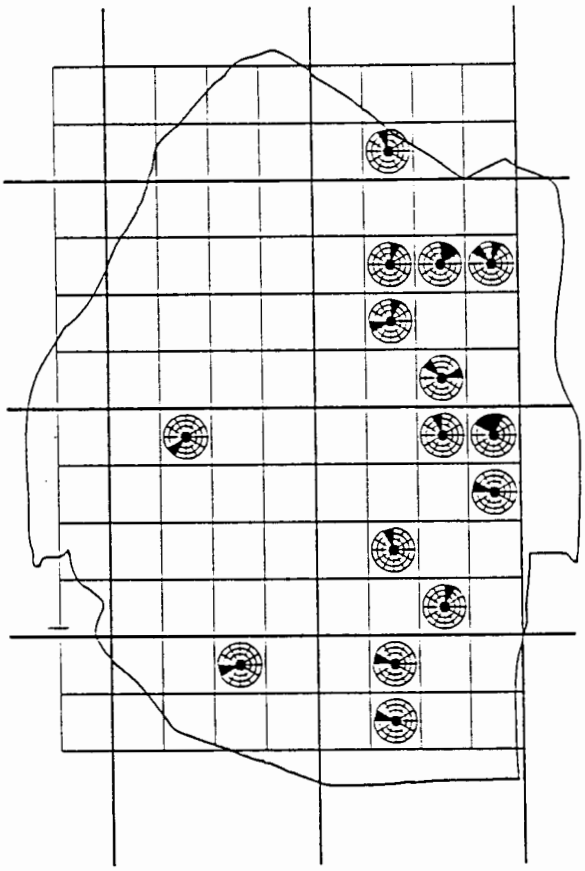
74. Greenbacked heron. (Butorides striatus)

Recording frequency: 273 (/2263)12%.
Population estimate: 400.
Status: Uncommon breeding resident in the lowveld and middleveld, where it is encountered singly or in pairs.
Habitat preference: Well-wooded rivers and streams and dams with reedbeds.



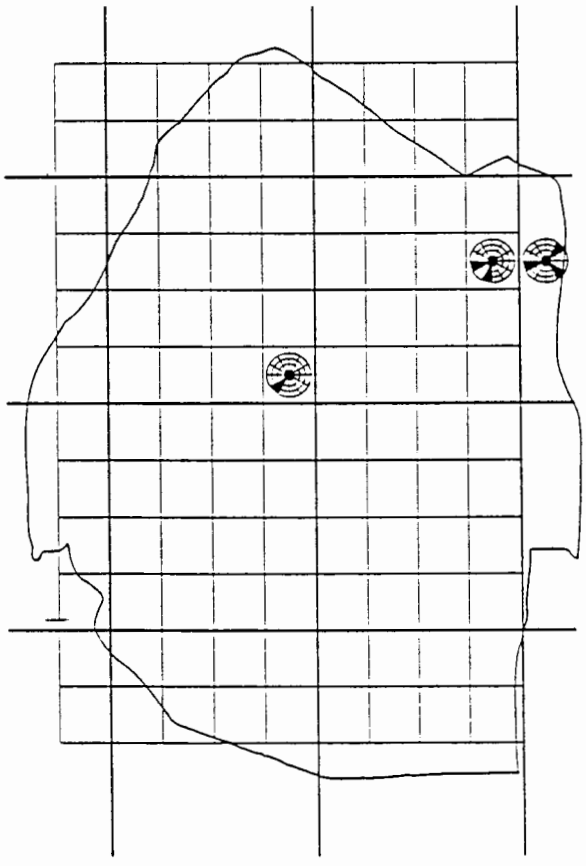
75. Rufousbellied heron. (Butorides rufiventris)

Recording frequency: 4 (/2263) 0,2%.
Status: Vagrant. One was seen at a small dam at Ngonini (A6) in October 1989 (VP), one at the settling pans at Matshapa (G5) in September 1988 (VP), one at the Simunye settling pans (D10) in September 1987 (T. & P. Sandiford) and one at Simunye Dam in February 1987 (VP).
Habitat preference: Dams.



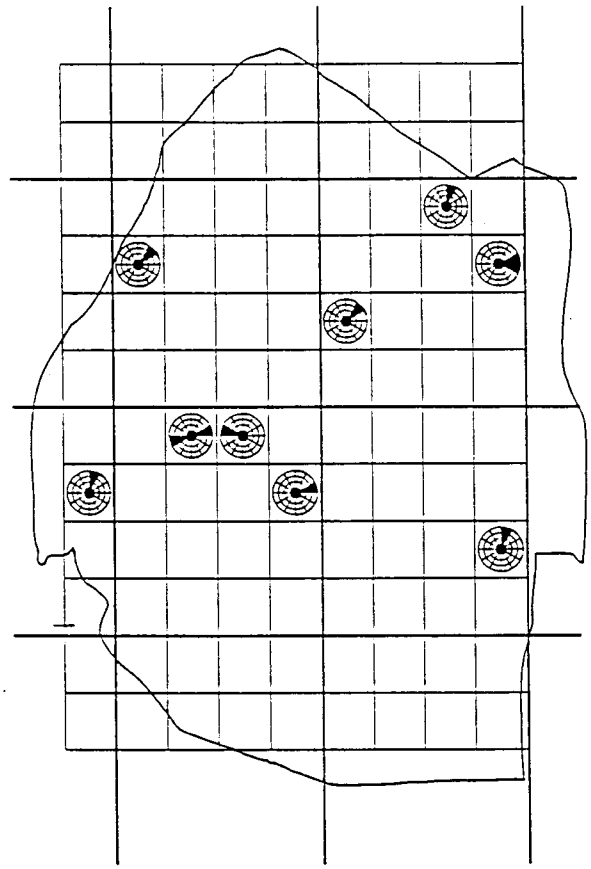
76. Blackcrowned night heron. (Nycticorax nycticorax)

Recording frequency: 21 (/2263) 1%.
Population estimate: 40.
Status: Uncommon resident (probably breeding) in the lowveld and vagrant in the middleveld. Encountered singly or in pairs.
Habitat preference: Dams.



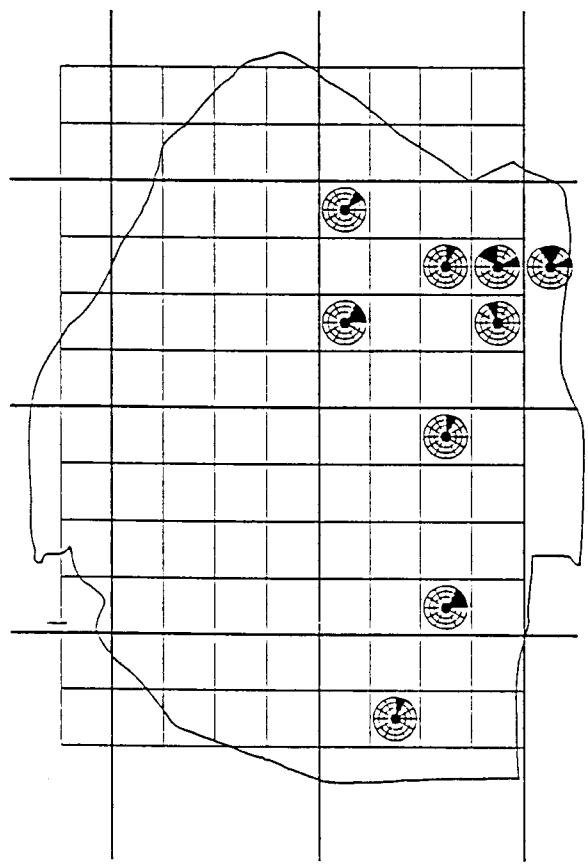
77. Whitebacked night heron. (Gorsachius leuconotus)

Recording frequency: 7 (/2263) 0,35%.
Population estimate: 10.
Status: Rare breeding resident in the lowveld and middleveld. Encountered singly or in pairs.
Habitat preference: Well-wooded streams.



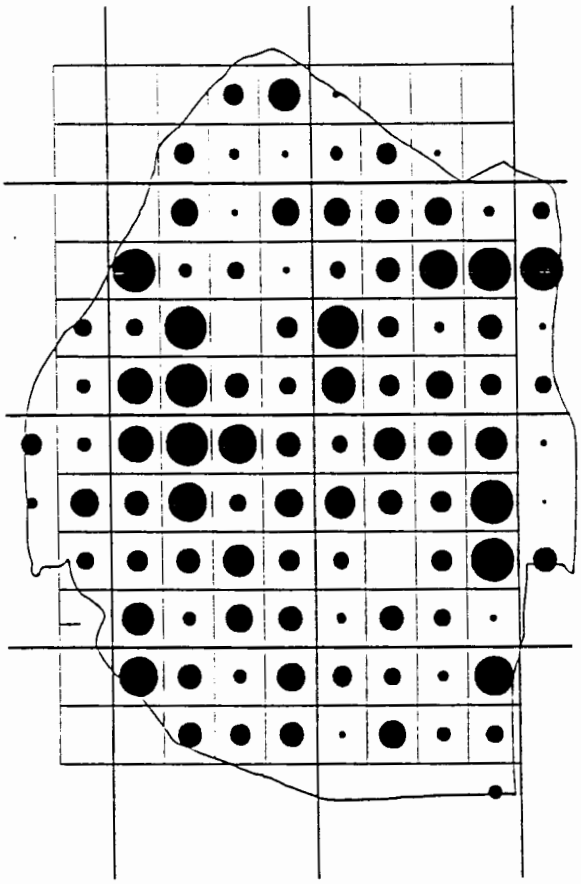
78. Little bittern. (Ixobrychus minutus)

Recording frequency: 11 (/2263) 0,45%.
Status: An uncommon summer migrant in all regions. Solitary.
Habitat preference: Dams with extensive reedbeds.



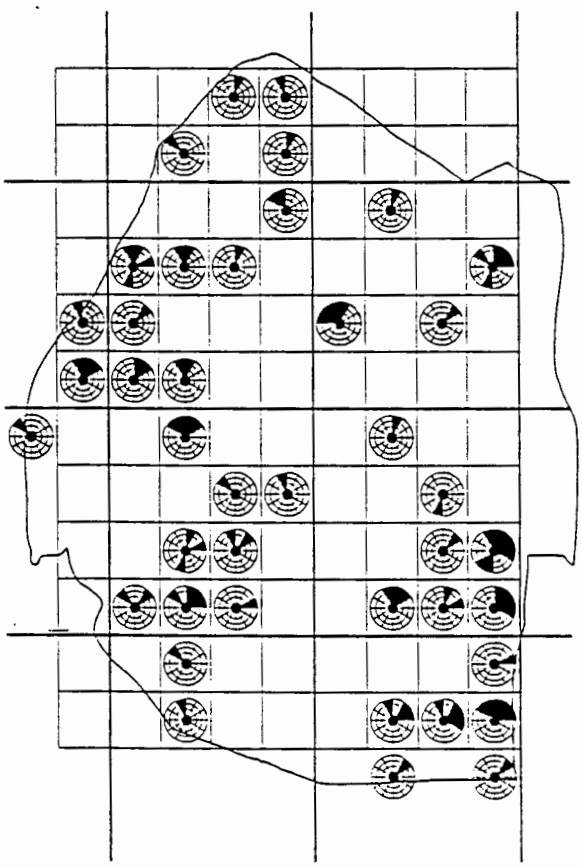
79. Dwarf bittern. (Ixobrychus sturmii)

Recording frequency: 15 (/2263) 1%.
Population estimate: 20.
Status: Uncommon summer migrant (probably breeding) in the lowveld and Lubombos. Found singly and in pairs.
Habitat preference: Small dams, ponds and pans.



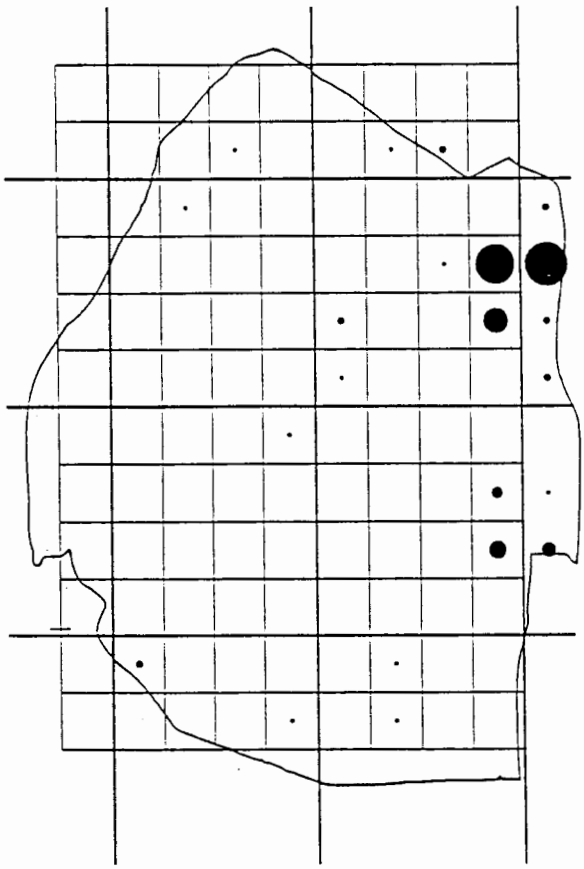
81. Hamerkop. (Scopus umbretta)

Recording frequency: 1 016 (/2263) 45%.
Population estimate: 800.
Status: A common breeding resident in all regions. Usually occurs in pairs but sometimes up to 20 birds gather around a drying pool.
Habitat preference: All types of wetlands. Often forages along tarred roads in the early morning, presumably feeding on small vertebrates crushed on the road during the night.



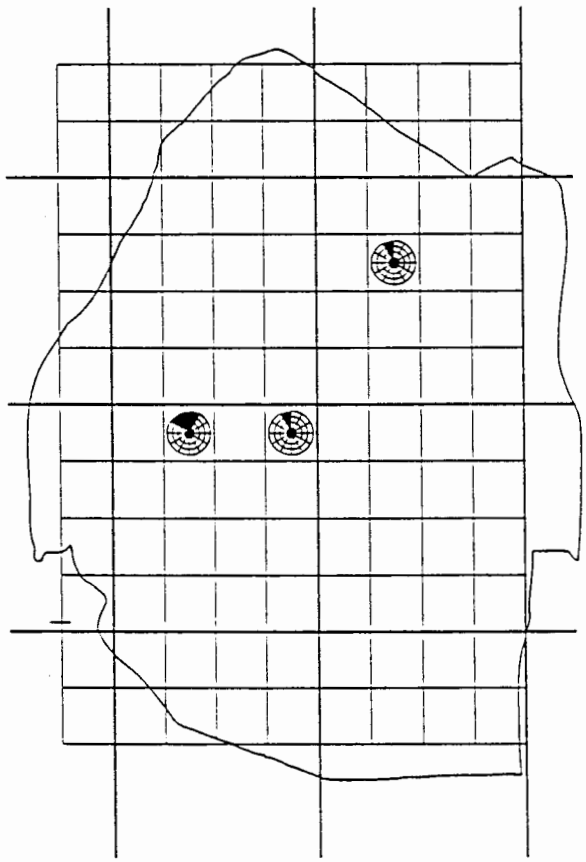
83. White stork. (Ciconia ciconia)

Recording frequency: 107 (/2263) 5%.
Status: Common summer migrant, with numbers varying greatly from year to year. In some years hundreds are seen in cotton fields in the southern lowveld. A few individuals usually overwinter in the lowveld and during the winter of 1991, small flocks were encountered at two localities in the highveld.
Habitat preference: Grassland and cultivated lands.



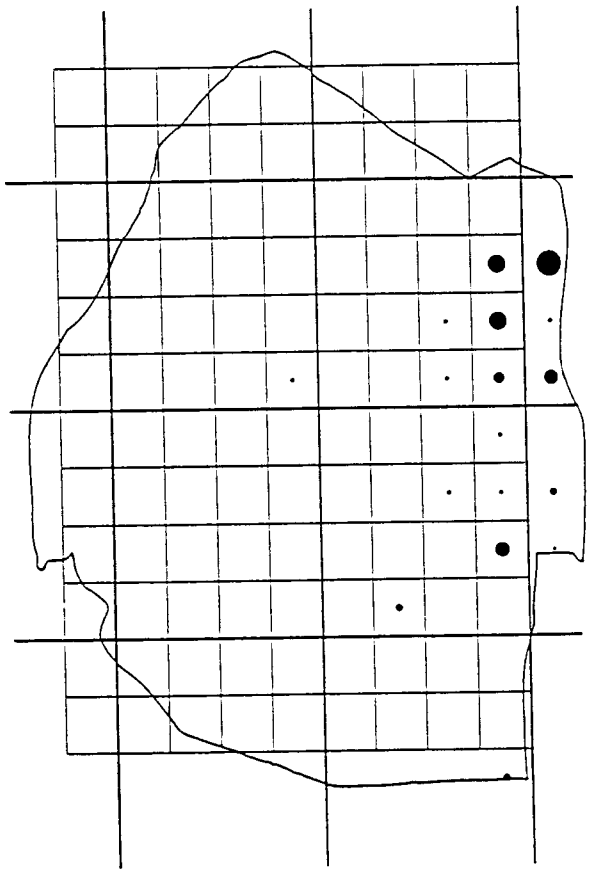
84. Black stork. (Ciconia nigra)

Recording frequency: 104 (/2263) 5%.
Population estimate: 20.
Status: Uncommon resident in the Lubombos and a vagrant in the middleveld and highveld. Breeding is believed to have occurred on cliffs in the Lubombos in Mlawula (D11) and in the Usutu Gorge (I11). Usually encountered singly or in pairs but sometimes in a flock of up to 20 birds.
Habitat preference: Forages along rivers and streams and at dams and breeds on cliffs in the Lubombo range.



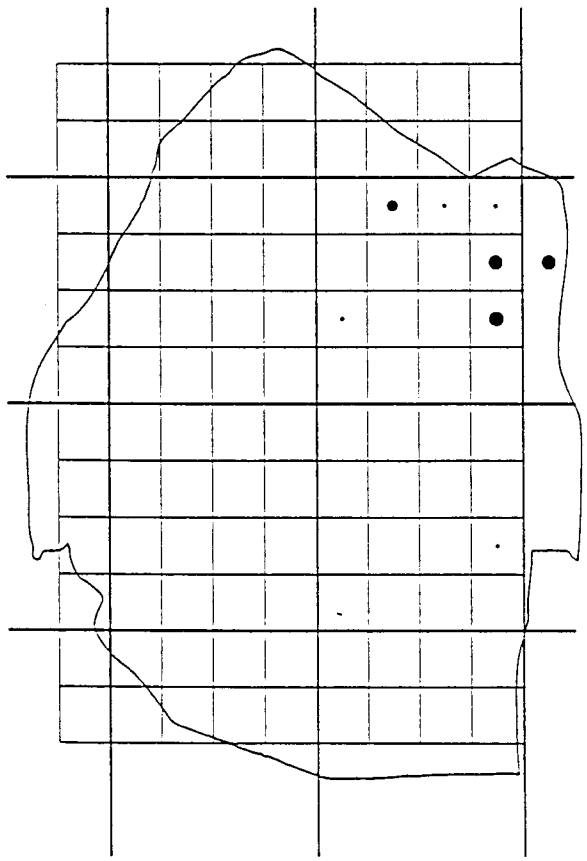
85. Abdim's stork. (Ciconia abdimii)

Recording frequency: 6 (/2263) 0,25%.
Status: Uncommon summer migrant, recorded regularly at Malkerns (G4) in the middleveld, usually in a flock of 4 or 5 birds and occasionally singly in the lowveld.
Habitat preference: Savanna, grassland and cultivated lands.



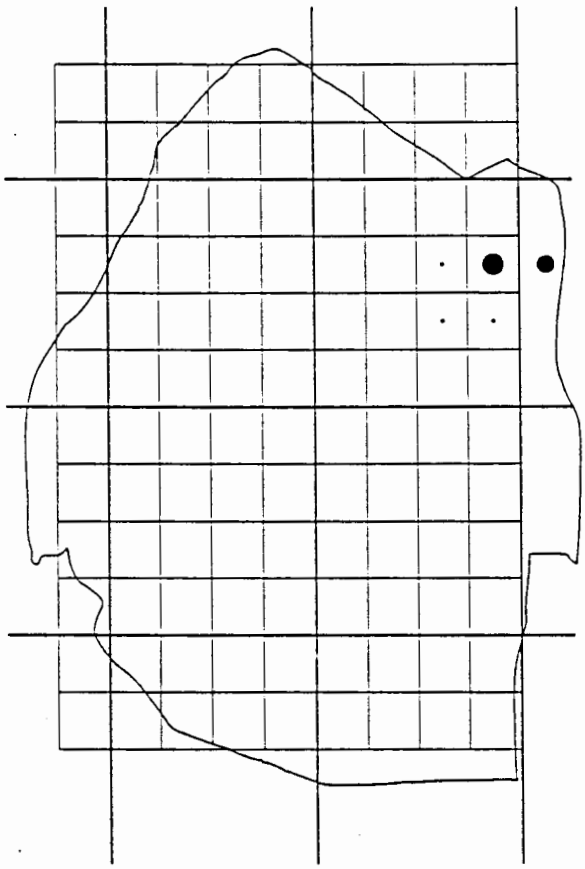
86. Woollynecked stork. (Ciconia episcopus)

Recording frequency: 48 (/2263) 2%.
Status: It is not certain whether the species is an uncommon visitor or a rare breeding resident in the lowveld and Lubombos. Encountered singly or in groups of up to 5 birds.
Habitat preference: Dams, rivers and pans.



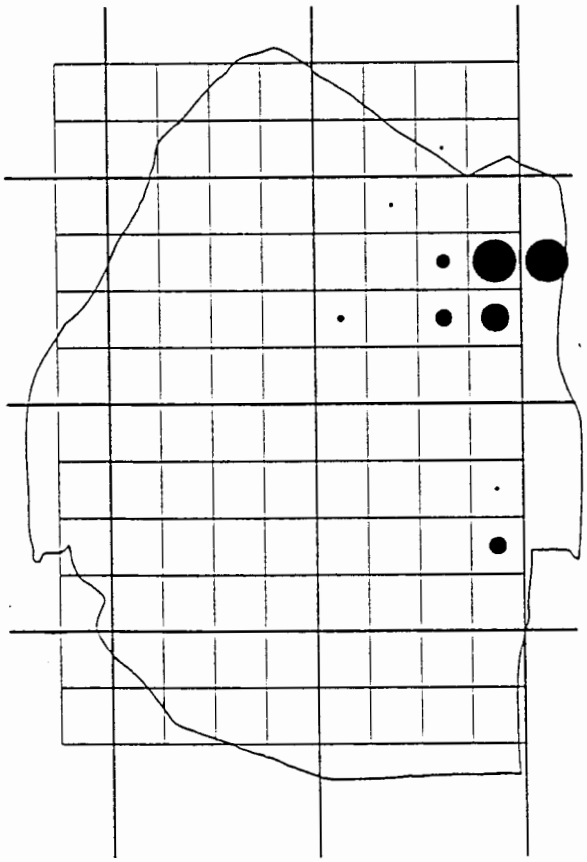
87. Openbilled stork. (Anastomus lamelligerus)

Recording frequency: 21 (/2263) 1%.
Status: Uncommon visitor to the lowveld. Encountered singly or in groups of up to 10 birds.
Habitat preference: Dams.



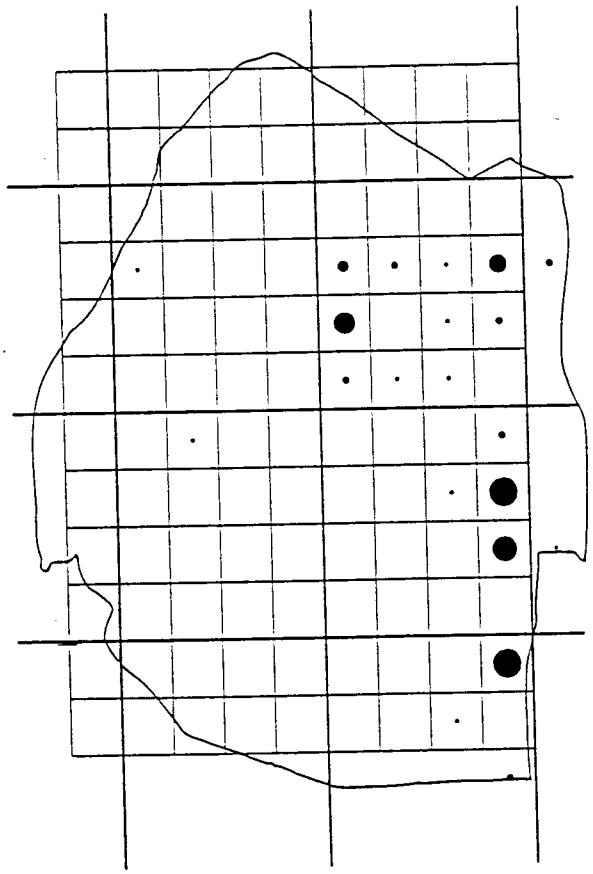
88. Saddlebilled stork. (Ephippiorhynchus senegalensis)

Recording frequency: 16 (/2263) 1%.
Population estimate: 4.
Status: A rare breeding resident, usually encountered singly or in pairs within the Hlane and Mlawula Nature Reserves and rarely elsewhere in the region.
Habitat preference: Encountered most often at pools in rivers and less often at small dams.



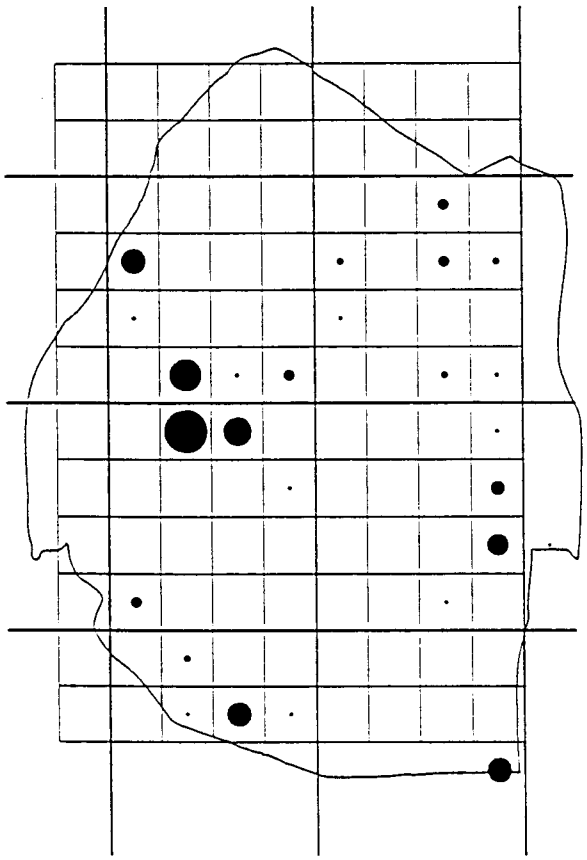
89. Marabou stork. (Leptoptilos crumeniferus)

Recording frequency: 100 (/2263) 4%.
Population estimate: 14.
Status: A rare breeding resident. Breeding occurs at two locations quite close together in the Hlane Nature Reserve. At each location there are three or four nests in a knobthorn (Acacia nigrescens) tree. Breeding at this locality was first reported in 1965 (Reilly and Wasdell). Since 1965, the habitat in the vicinity has altered from open savanna to scrubby Dichrostachys woodland with minimal grass cover. Reports that a breeding site in Swaziland was destroyed for sugar cane development (Brooke; Elwell) presumably refer to a different site. This is believed to be the only breeding locality for the species south of the Limpopo (Brooke).
Habitat preference: Woodland, savanna, dams and pans. Breeding occurs in acacia woodland near a seasonal pan.



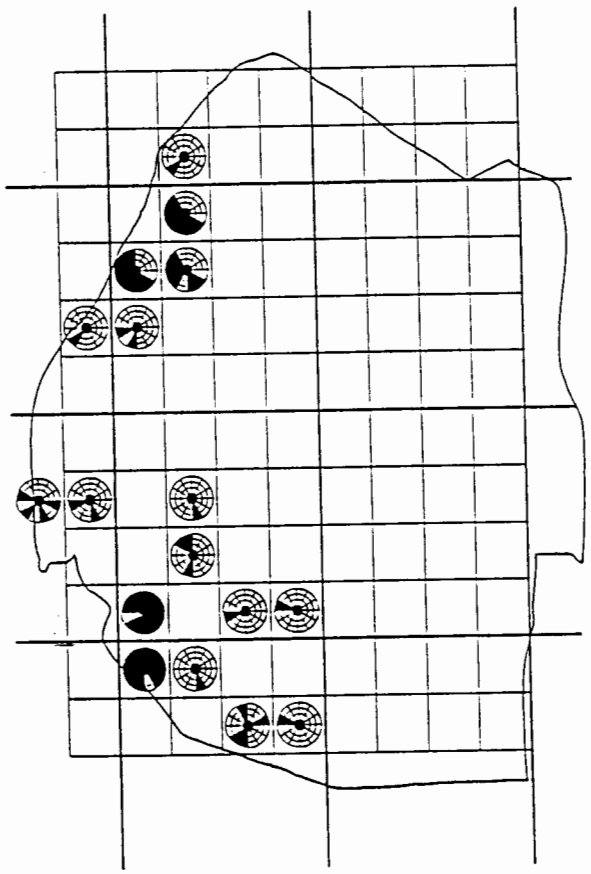
90. Yellowbilled stork. (Mycteria ibis)

Recording frequency: 70 (/2263) 3%.
Population estimate: 10.
Status: Rare resident (probably breeding) in the lowveld where it occurs in flocks of up to ten birds and a vagrant in the middleveld and highveld.
Habitat preference: Dams and rivers.



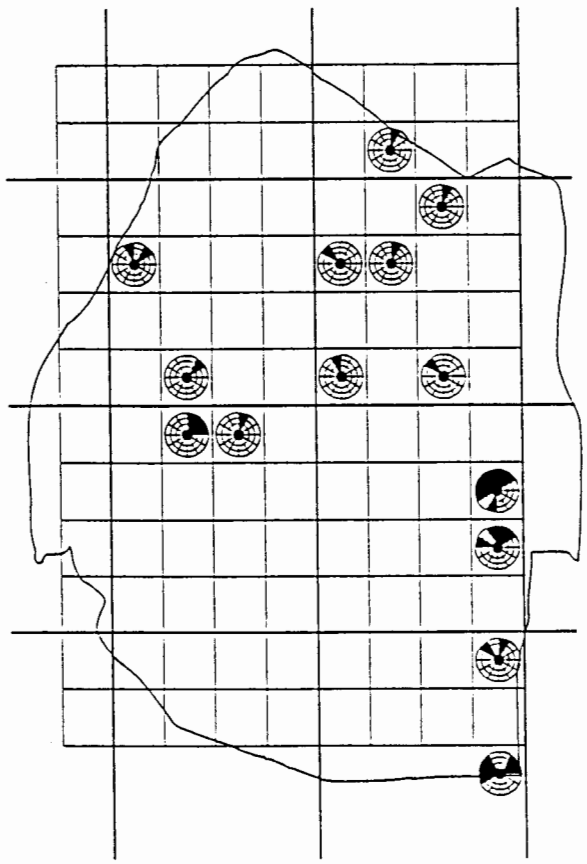
91. Sacred ibis. (Threskiornis aethiopicus)

Recording frequency: 159 (/2263) 7%.
Population estimate: 20.
Status: An uncommon breeding resident in the middleveld and uncommon visitor to the highveld and lowveld. Usually encountered in small flocks of up to 10 birds but flocks of up to 50 birds are sometimes encountered around Matsapha (G5). Many of the birds seen may be non breeding visitors to Swaziland, hence the low population estimate.
Habitat preference: Dams and vleis.



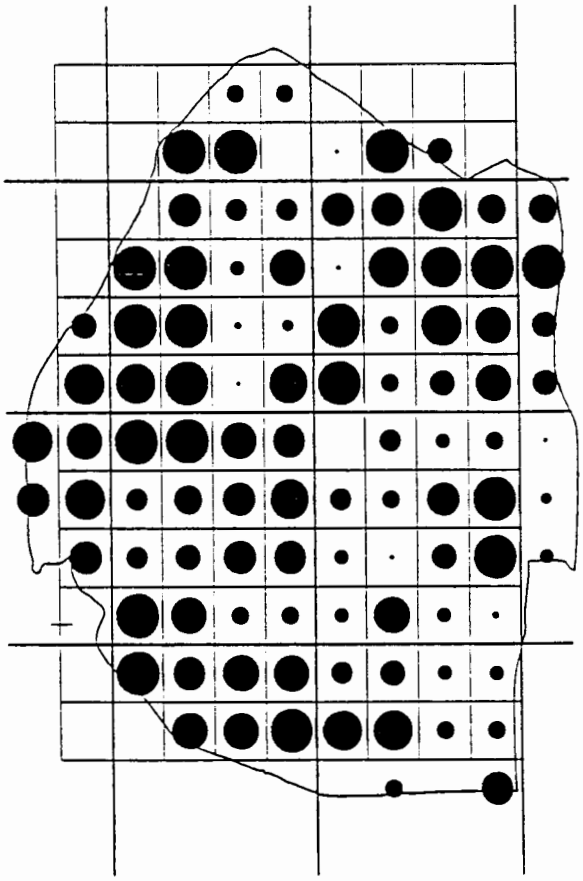
92. Bald ibis. (Geronticus calvus)

Recording frequency: 81 (/2263) 4%.
Population estimate: 110.
Status: The species is a breeding resident around Nhlangano in the south and a breeding winter migrant to Malolotja in the north of the highveld. A breeding colony at Mahamba (K3) and another near Gege (J3) each contain 20 nests or more while the colony at Malolotja (C4) usually contains 10 to 14 nests. At other localities, nests occur singly or in smaller colonies.
Habitat preference: Forages in highveld grassland, especially recently burned grassland and breeds on cliffs above rivers.



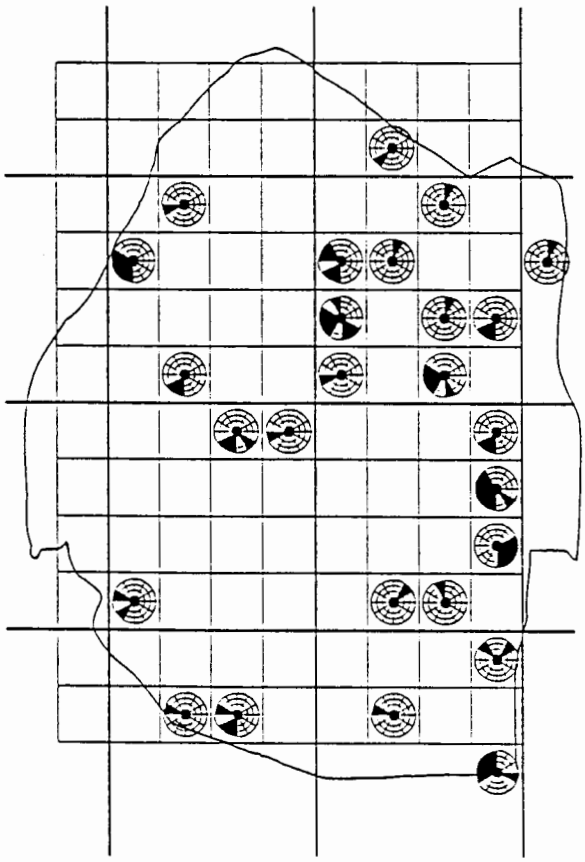
93. Glossy ibis. (Plegadis falcinellus)

Recording frequency: 33 (/2263) 1%.
Status: An uncommon summer visitor to all regions, encountered in small flocks of up to 10 birds.
Habitat preference: Dams.



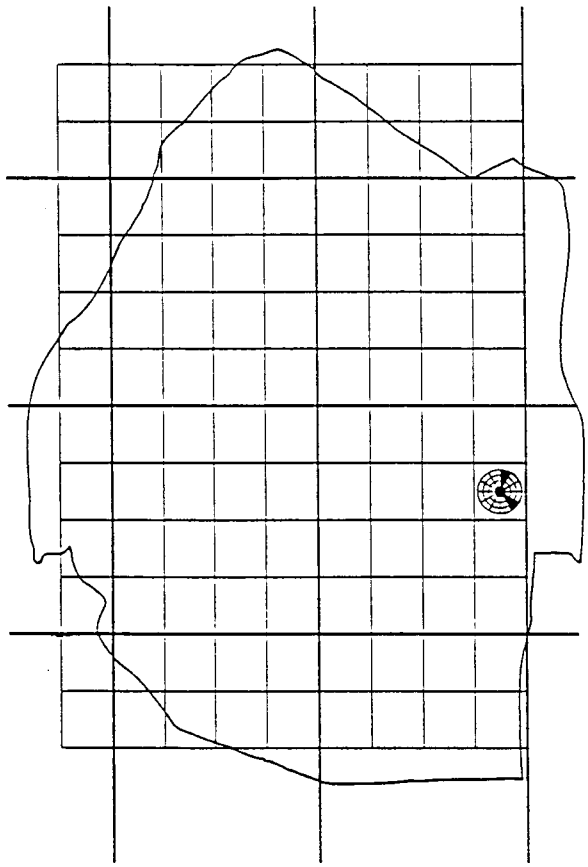
94. Hadeda ibis. (Bostrychia hagedash)

Recording frequency: 1 312 (/2263) 58%.
Population estimate: 2 000.
Status: A common breeding resident in all regions. Encountered singly, in pairs or in small flocks of up to 20 birds.
Habitat preference: Has been encountered in all habitat types. Breeds in dense woodland.



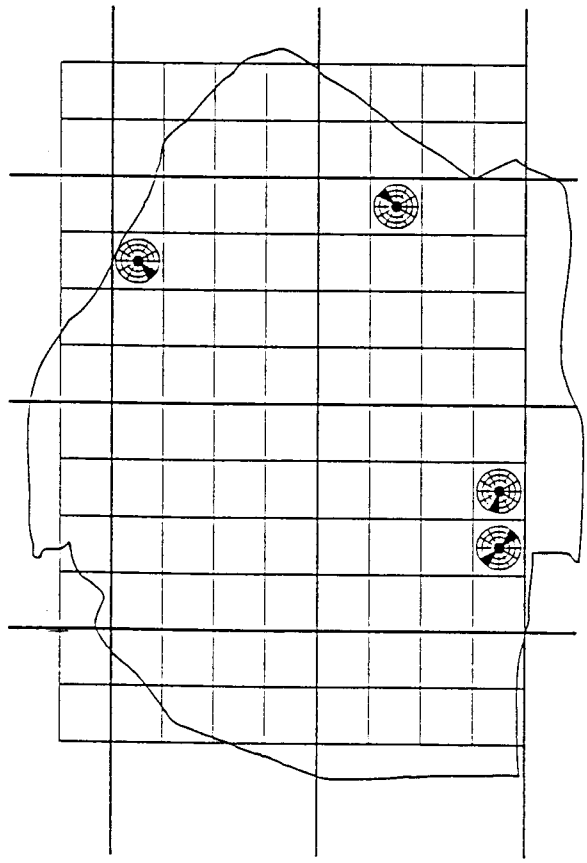
95. African spoonbill. (Platalea alba)

Recording frequency: 65 (/2263) 3%.
Population estimate: 10.
Status: A rare resident in the lowveld and uncommon visitor elsewhere. Breeding has occurred on an island at Mnjoli Dam. Encountered singly or in small flocks of up to 10 birds.
Habitat preference: Dams and vleis.



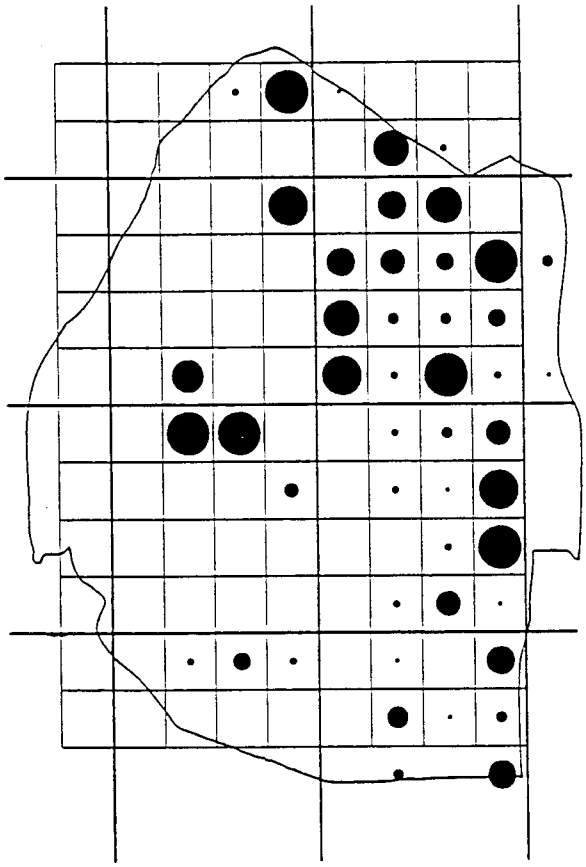
96. Greater flamingo. (Phoenicopterus ruber)

Recording frequency: 2 (/2263) 0,1%.
Status: Rare vagrant to the lowveld, usually encountered singly.
Habitat preference: Dams.



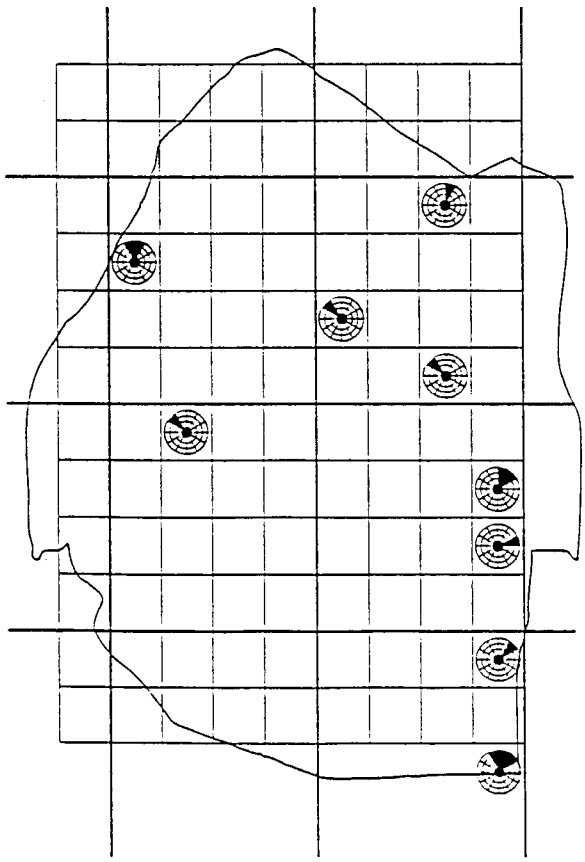
97. Lesser flamingo. (Phoenicopterus minor)

Recording frequency: 6 (/2263) 0,3%.
Status: Rare vagrant. Usually seen in small flocks of up to 20 birds. Has been seen on sandbanks in the Usutu River near Big Bend (I10) in August of two successive years. Several birds were seen among flooded sugar cane fields near Simunye (D10) in the aftermath of Cyclone Demoina in February 1984 (J. Culverwell pers. comm.)
Habitat preference: Dams and rivers.



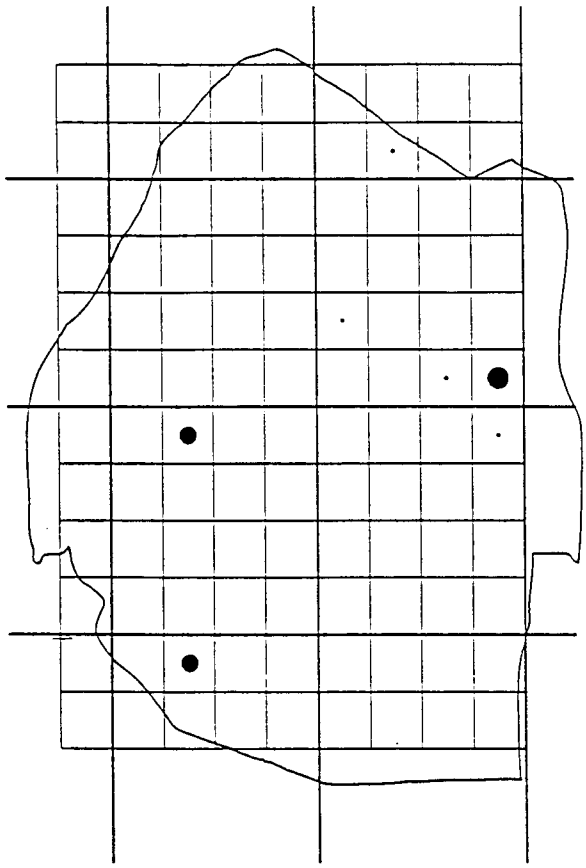
99. Whitefaced duck. (Dendrocygna viduata)

Recording frequency: 393 (/2263) 17%.
Population estimate: 3 000.
Status: Common breeding resident in the lowveld and middleveld and an uncommon visitor in the Lubombos. Occurs in small or large flocks numbering up to 200 birds. Was reported from the highveld for the first time, at Hawane Dam (D3), in 1992, after data collection for the atlas had been completed.
Habitat preference: Dams.



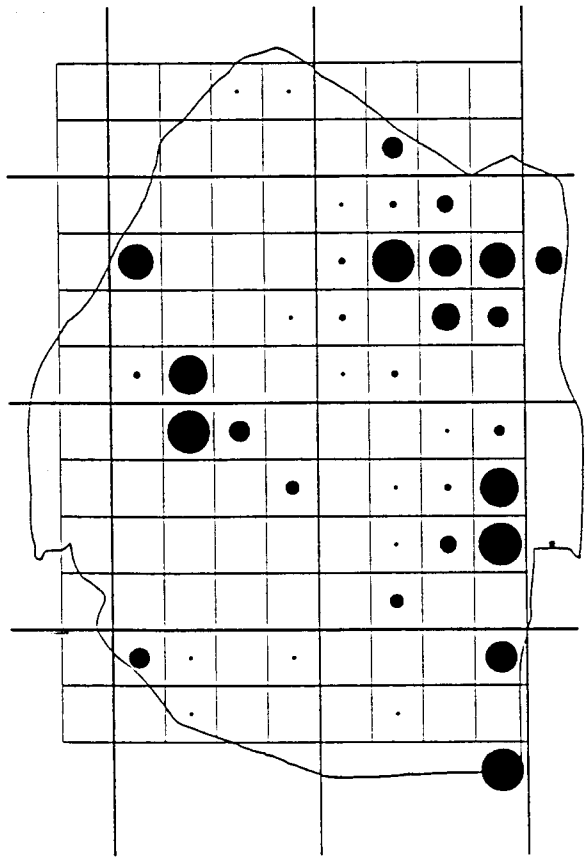
100. Fulvous duck. (Dendrocygna bicolor)

Recording frequency: 13 (/2263) 1%.
Status: An uncommon summer visitor. Encountered in small flocks of up to 10 birds.
Habitat preference: Dams.



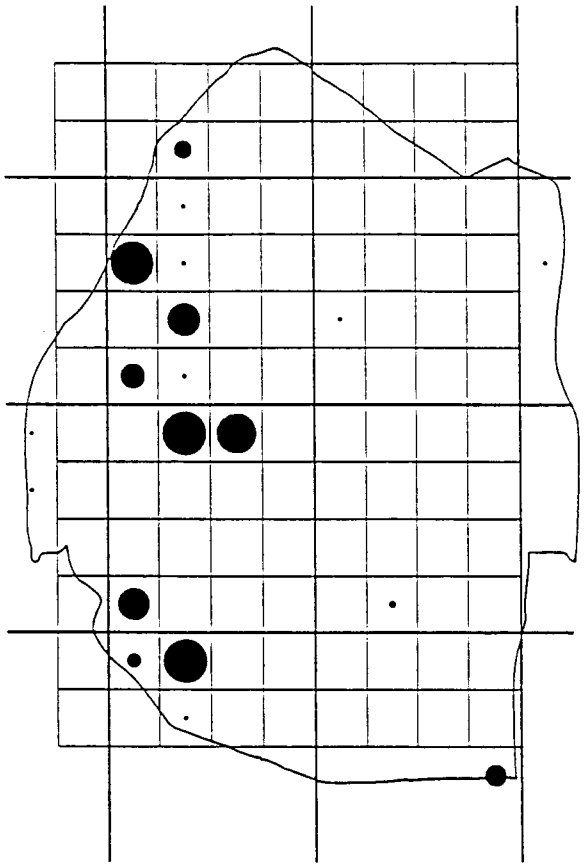
101. Whitebacked duck. (Thalassornis leuconotus)

Recording frequency: 21 (/2263) 1%.
Population estimate: 10.
Status: An uncommon resident, recorded breeding at Siteki (F10) in the Lubombos. Usually encountered in pairs.
Habitat preference: Small dams with waterlilies and other floating vegetation.



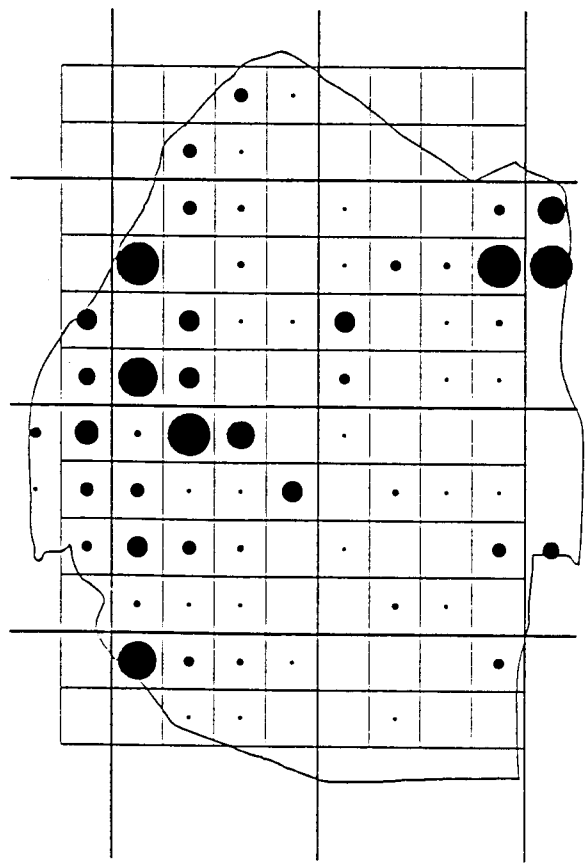
102. Egyptian goose. (Alopochen aegyptiacus)

Recording frequency: 335 (/2263) 15%.
Population estimate: 400.
Status: An uncommon breeding resident in all regions, usually encountered in pairs but sometimes gathers in flocks of up to 100 birds on the shores of large lowveld dams during the winter months.
Habitat preference: Rivers and dams.



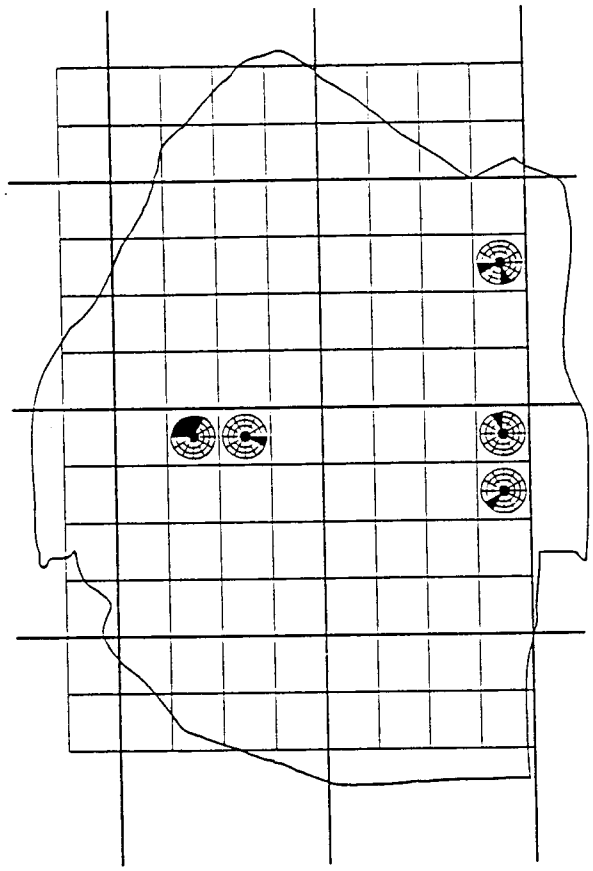
104. Yellowbilled duck. (Anas undulata)

Recording frequency: 184 (/2263) 8%.
Population estimate: 400.
Status: A common breeding resident in the highveld, a vagrant in the northern lowveld and rare breeding resident in the south of the lowveld. Encountered in pairs or in flocks of up to 50 birds.
Habitat preference: Dams and vleis.



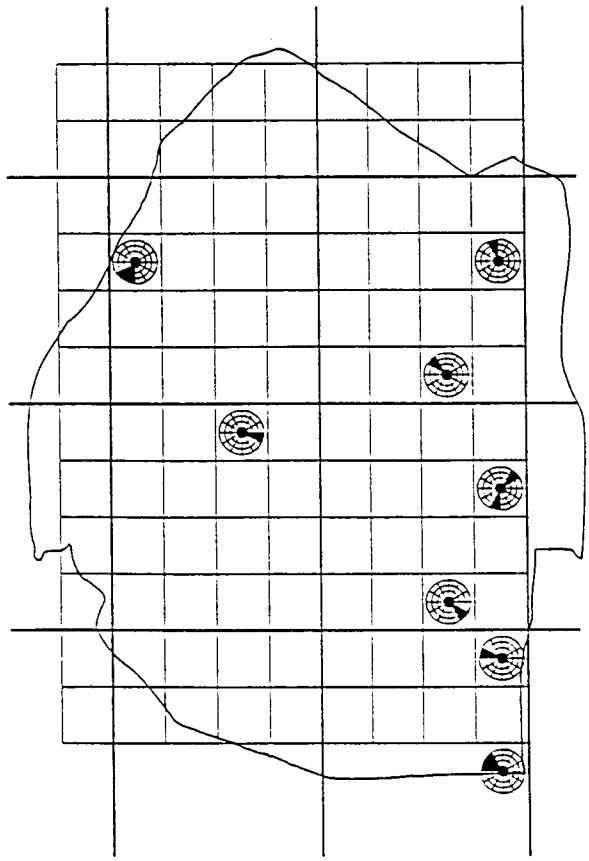
105. African black duck. (Anas sparsa)

Recording frequency: 371 (/2263) 16%.
Population estimate: 500.
Status: A common breeding resident.
Habitat preference: Usually encountered in pairs on rivers and occasionally on dams.



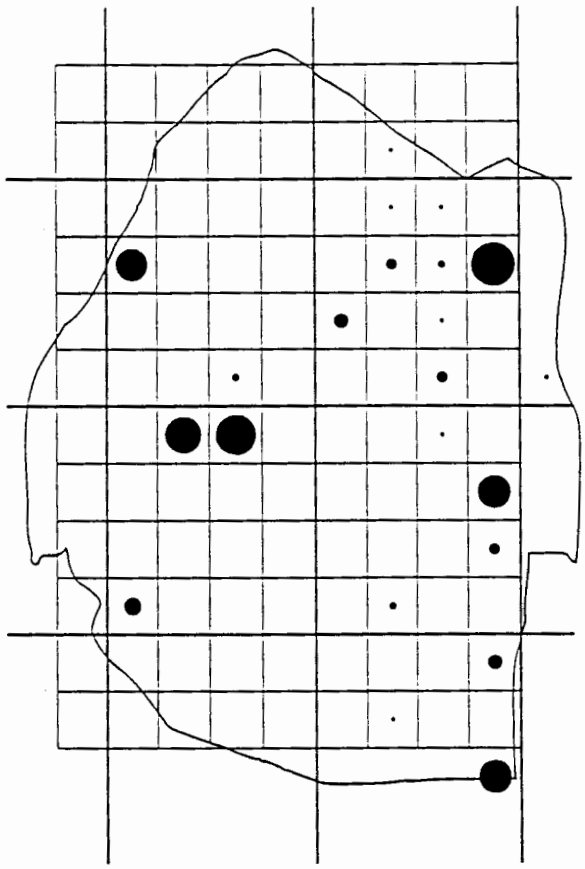
106. Cape teal. (Anas capensis)

Recording frequency: 9 (/2263) 0,4%.
Status: An uncommon visitor to the middleveld and lowveld. Usually encountered singly or in pairs.
Habitat preference: Dams.



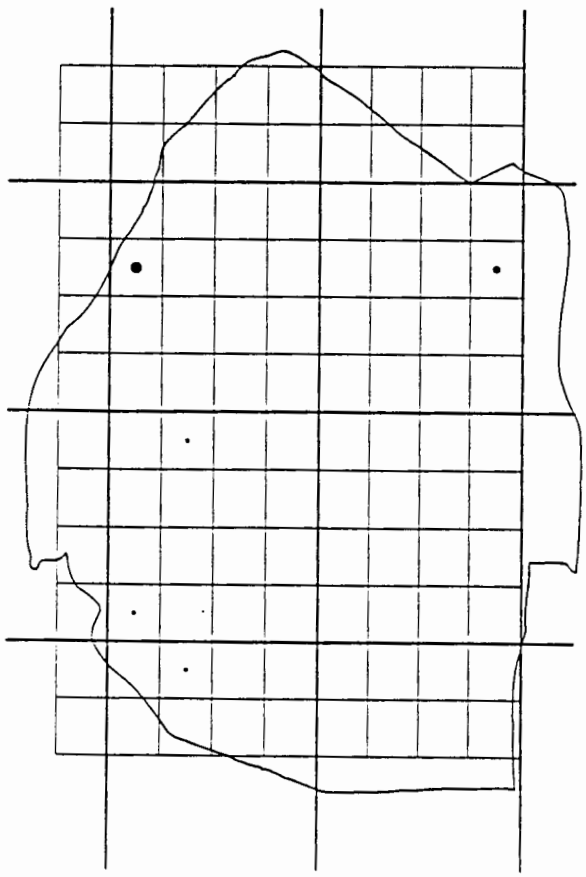
107. Hottentot teal. (Anas hottentota)

Recording frequency: 11 (/2263) 0,45%.
Status: An uncommon visitor, encountered singly, in pairs or in flocks of up to 10 birds.
Habitat preference: Dams.



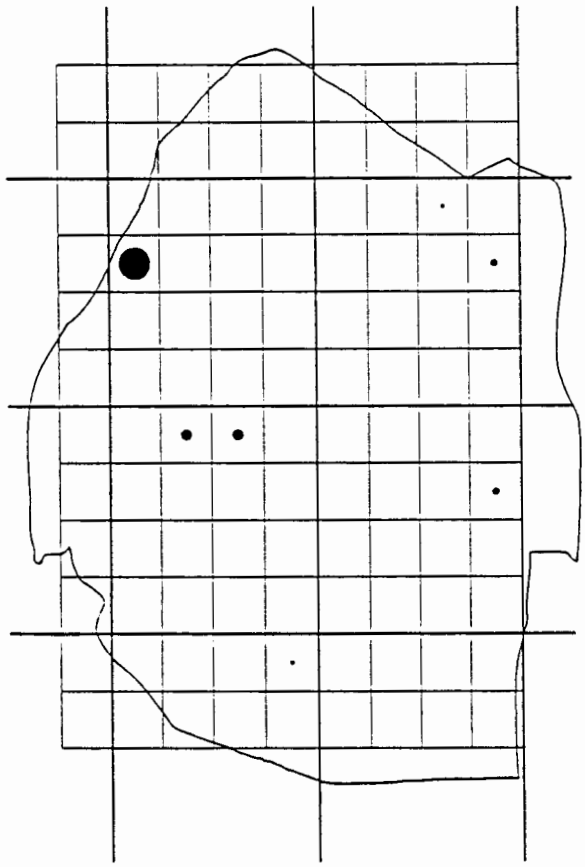
108. Redbilled teal. (Anas erythrorhyncha)

Recording frequency: 129 (/2263) 6%.
Population estimate: 40.
Status: An uncommon breeding resident, usually encountered in pairs or in small flocks of up to 10 birds.
Habitat preference: Dams and vleis.



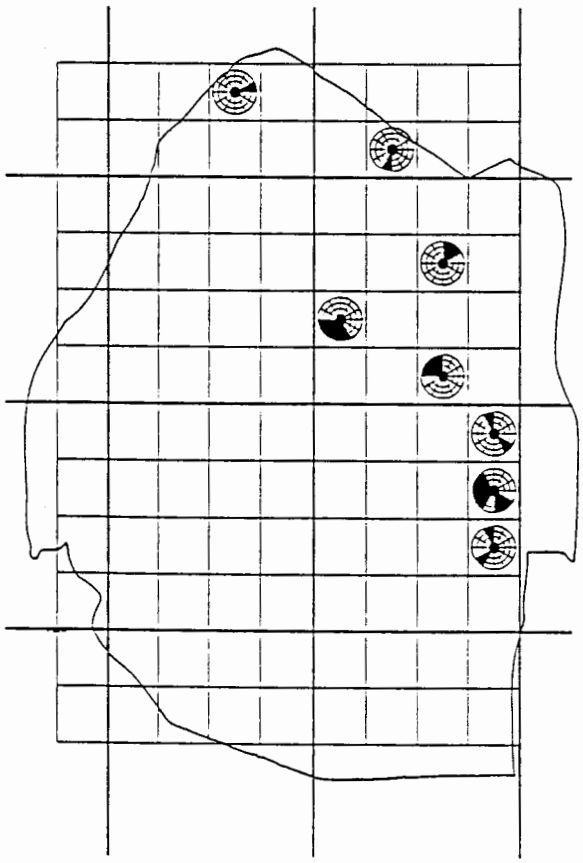
112. Cape shoveller. (Anas smithii)

Recording frequency: 8 (/2263) 0,35%.
Status: An uncommon visitor, encountered singly or in flocks of up to 10 birds.
Habitat preference: Dams.



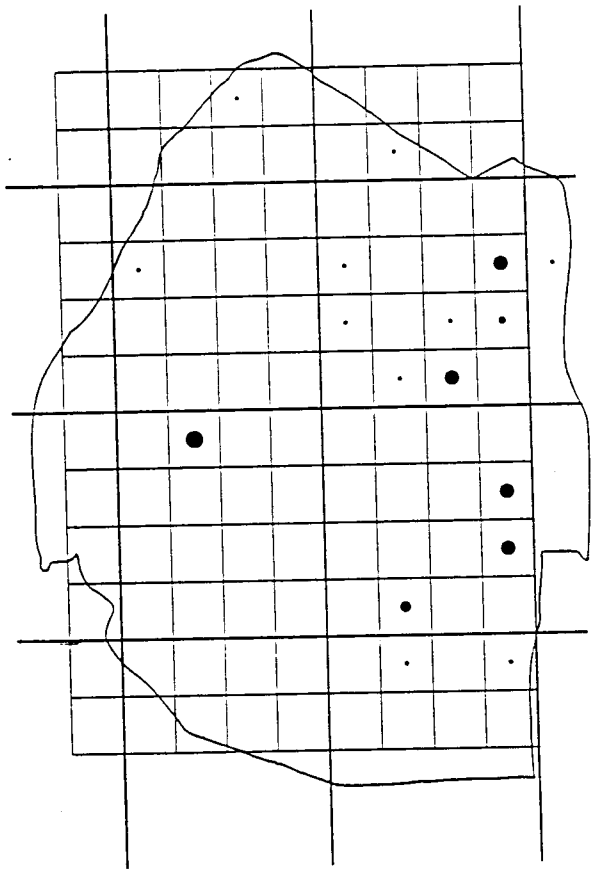
113. Southern pochard. (Netta erythrophthalma)

Recording frequency: 28 (/2263) 1%.
Population estimate: 10.
Status: A breeding resident only at Hawane Dam (D3) in the highveld and an uncommon visitor elsewhere. Encountered singly or in flocks of up to 20 birds.
Habitat preference: Dams.



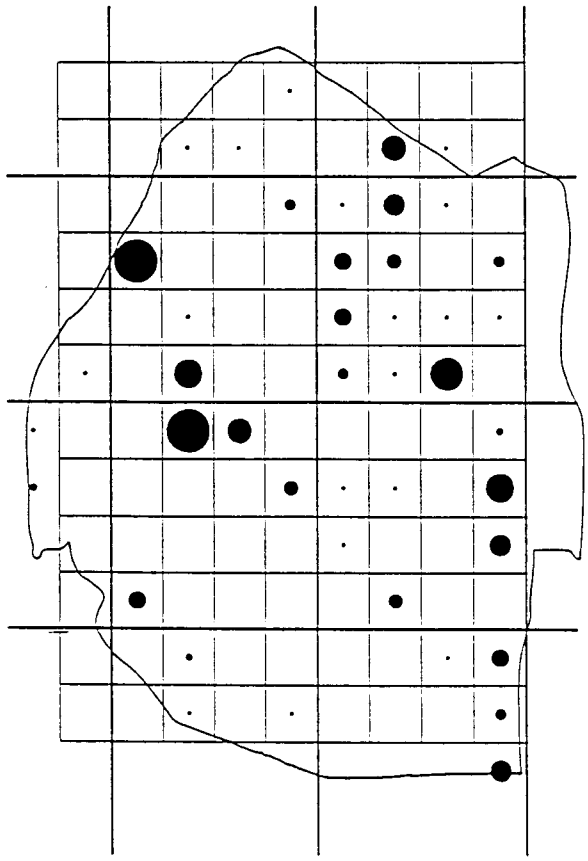
114. Pygmy goose. (Nettapus auritas)

Recording frequency: 25 (/2263) 1%.
Status: It is not certain whether this species is a breeding resident or an uncommon visitor to the lowveld. Encountered in pairs or in flocks of up to 20 birds.
Habitat preference: Small dams with floating vegetation (especially waterlilies)



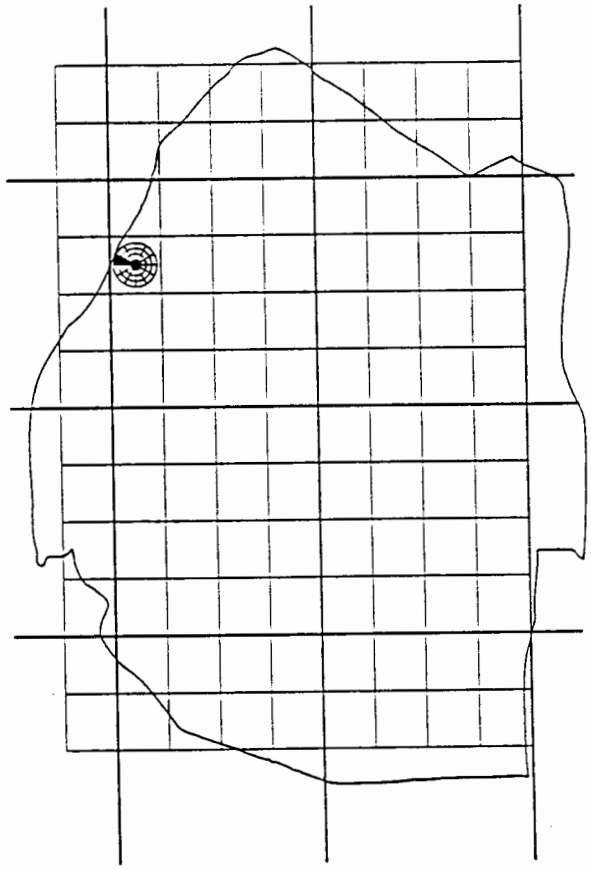
115. Knobbilled duck. (Sarkidiornis melanotos)

Recording frequency: 38 (/2263) 2%.
Population estimate: 10.
Status: An uncommon resident (probably breeding) in the lowveld and a vagrant in the middleveld and highveld. Encountered in pairs or in flocks of up to 10 birds.
Habitat preference: Dams.



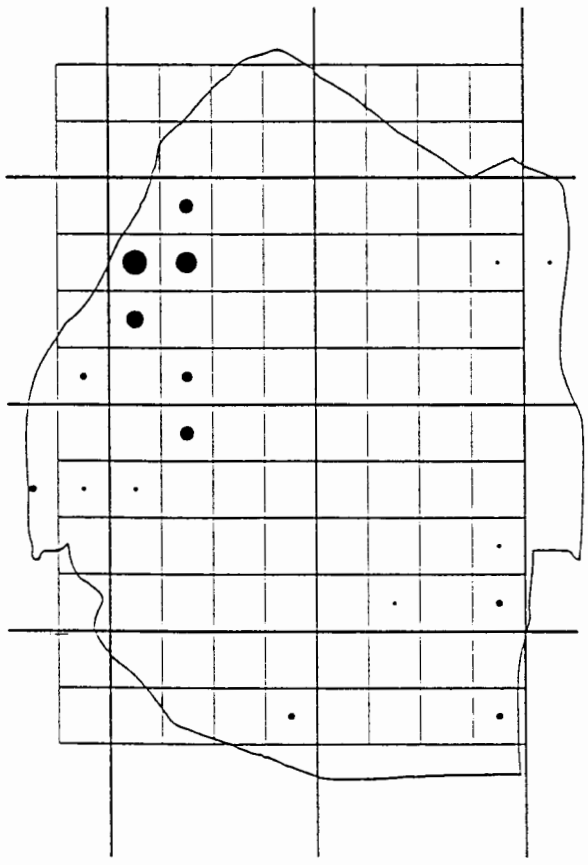
116. Spurwinged goose. (Plectropterus gambensis)

Recording frequency: 269 (/2263) 12%.
Population estimate: 100.
Status: Common breeding resident. Usually found in small flocks of up to 50 birds.
Habitat preference: Dams and vleis.



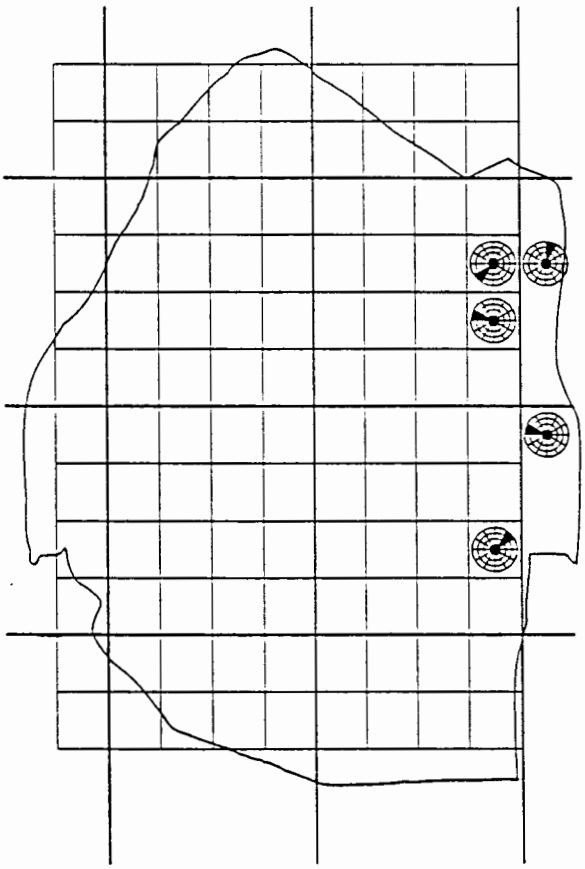
117. Maccoa duck. (Oxyura maccoa)

Recording frequency: 1 (/2263) 0,05%.
Status: A vagrant recorded at Hawane dam (D3) in October 1987 (D. & D. Hill)



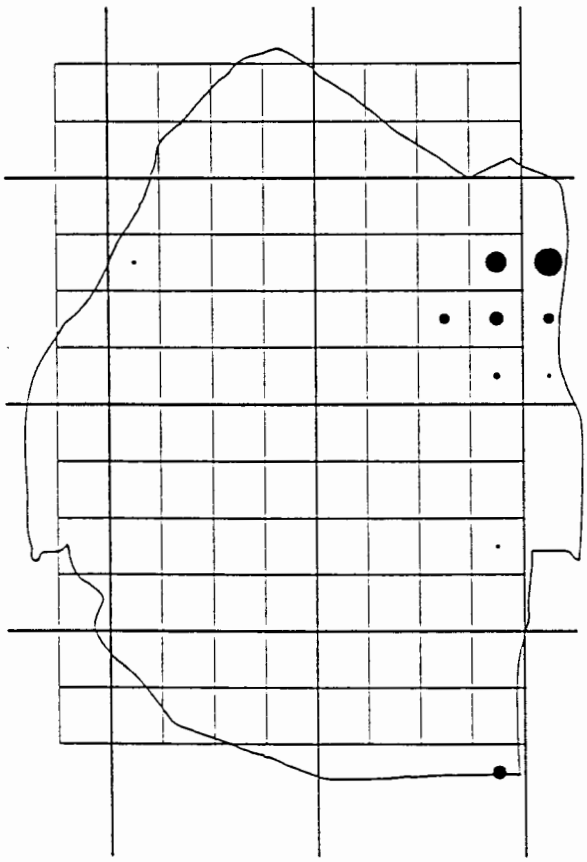
118. Secretarybird. (Sagittarius serpentarius)

Recording frequency: 50 (/2263) 2%.
Population estimate: 50.
Status: A breeding resident, uncommon in the highveld and rare in the middleveld and lowveld. Used to be far more common in the lowveld (J. Culverwell pers. comm.), but bush encroachment has reduced the suitability of much of the lowveld for this species.
Habitat preference: Grassland and savanna.



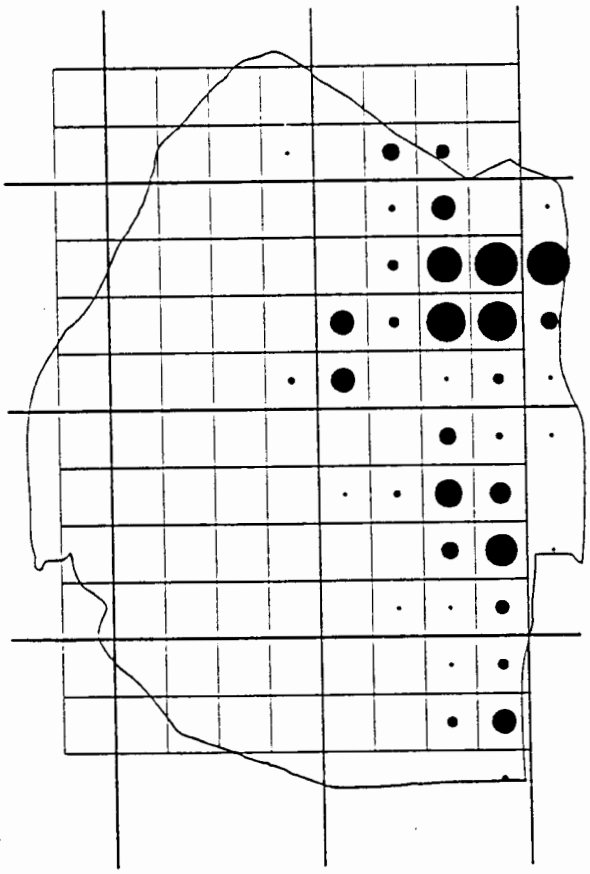
121. Hooded vulture. (Necrosyrtes monachus)

Recording frequency: 5 (/2263) 0,25%.
Status: Vagrant. A bird was seen at Mlawula (D10, D11) in January 1986 (J. Culverwell) and in August 1986 (J. Culverwell), at Big Bend (I10) in February 1988 (VP) and one near Jilobi (G11) in the Lubombos in October 1989 (VP).
Habitat preference: Woodland and savanna.



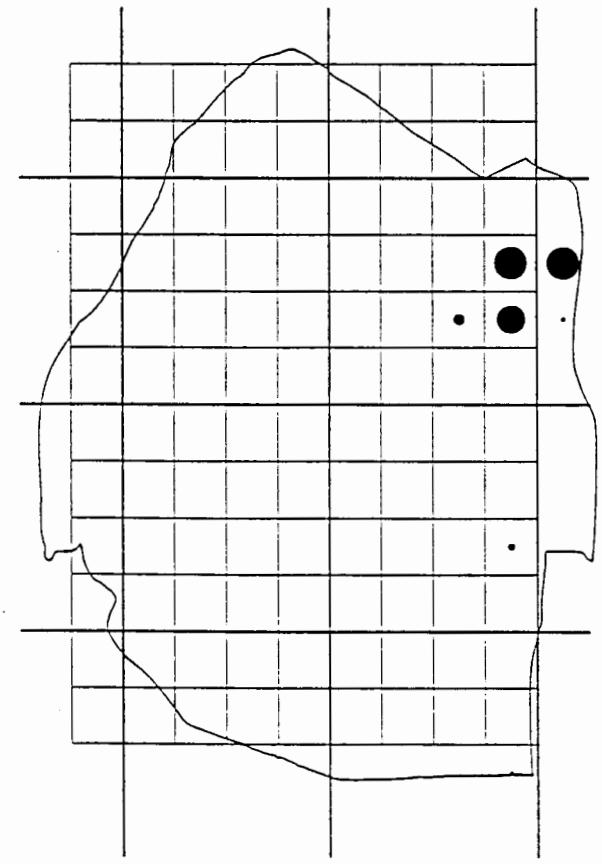
122. Cape vulture. (Gyps coprotheres)

Recording frequency: 44 (/2263) 2%.
Status: A regular visitor to the lowveld and Lubombos. A small breeding colony (10 - 15 nests) is located in Mocambique within 5 km of the Swaziland border in the Lubombo range (A. Robertson, pers. comm.). The species is now recorded only as a vagrant in the highveld, although it is believed to have bred at Umkhobolondo mountain (B5) in the northwest prior to 1972 (Piper, Mundy & Vernon).
Habitat preference: Woodland and savanna.



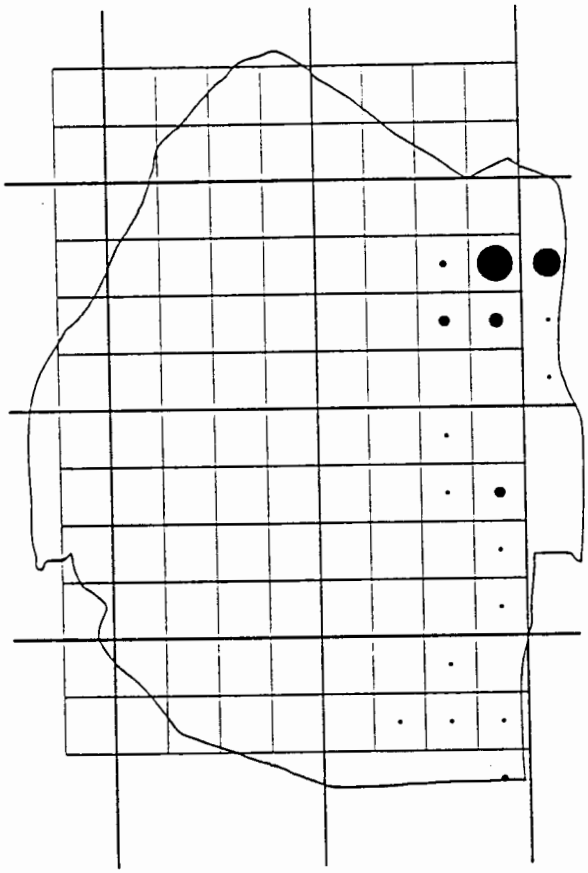
123. Whitebacked vulture. (Gyps africanus)

Recording frequency: 290 (/2263) 13%.
Population estimate: 400.
Status: A common breeding resident in the lowveld and a frequent visitor in the Lubombos. Up to 200 birds have been seen together at a carcass. Nests are usually in loose colonies of 4 or 5 nests in riverine woodland but occasional nests occur singly in savanna.
Habitat preference: Woodland and savanna.



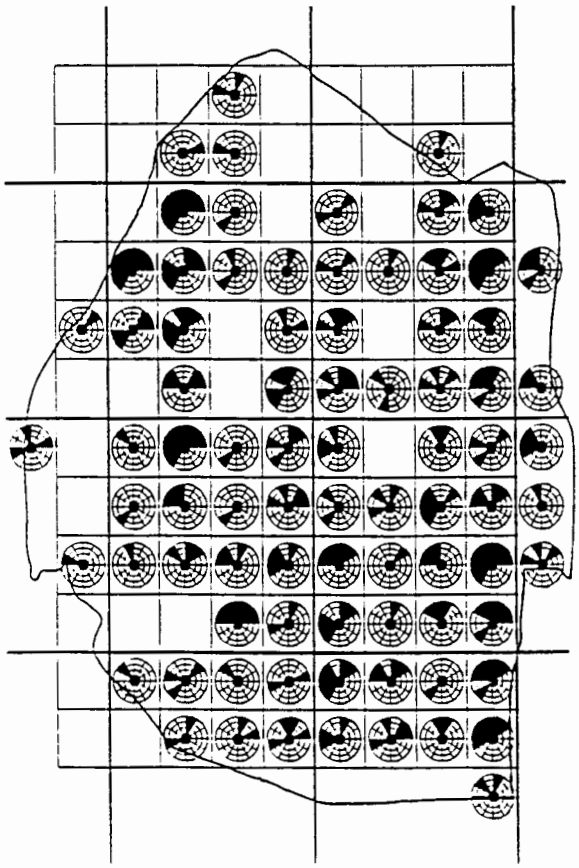
124. Lappetfaced vulture. (Torgos tracheliotus)

Recording frequency: 61 (/2263) 3%.
Population estimate: 6.
Status: A rare resident in the lowveld which is encountered regularly only within the Hlane and Mlawula nature reserves. Breeding has been observed in Hlane (R. Girdwood, J. Culverwell, pers. comm.) The species used to occur far more widely in the lowveld (J. Culverwell, pers. comm.).
Habitat preference: Woodland and savanna.



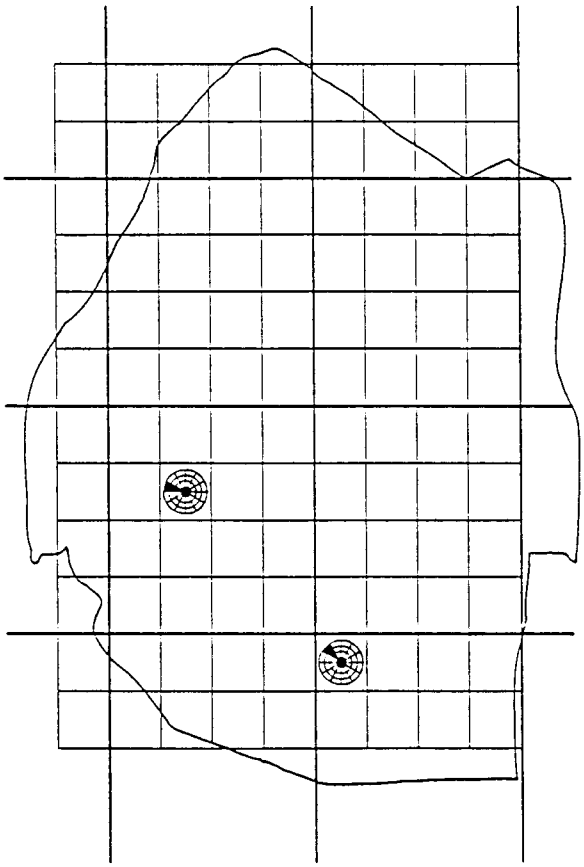
125. Whiteheaded vulture. (Trigonoceps occipitalis)

Recording frequency: 66 (/2263) 3%.
Population estimate: 12.
Status: A rare resident species which breeds within the Hlane, Mkhaya and Mlawula Nature Reserves (J. Culverwell, T. Reilly pers. comm.) and possibly also in the south of the lowveld near Lavumisa.
Habitat preference: Woodland and savanna.



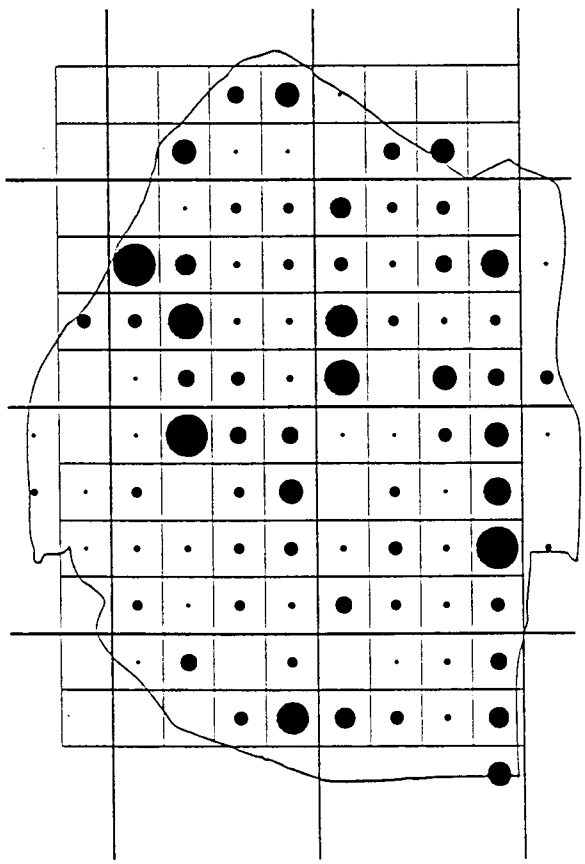
126. Yellowbilled kite. (Milvus parasitus)

Recording frequency: 256 (/2263) 11%.
Population estimate: 10.
Status: A common summer migrant, with a few birds breeding in the lowveld and Lubombos. The birds are most numerous during August and March. It is believed that most of the birds encountered in Swaziland are either passage migrants or non breeding juveniles, with very few birds breeding in Swaziland.
Habitat preference: Encountered in all habitats except forest.



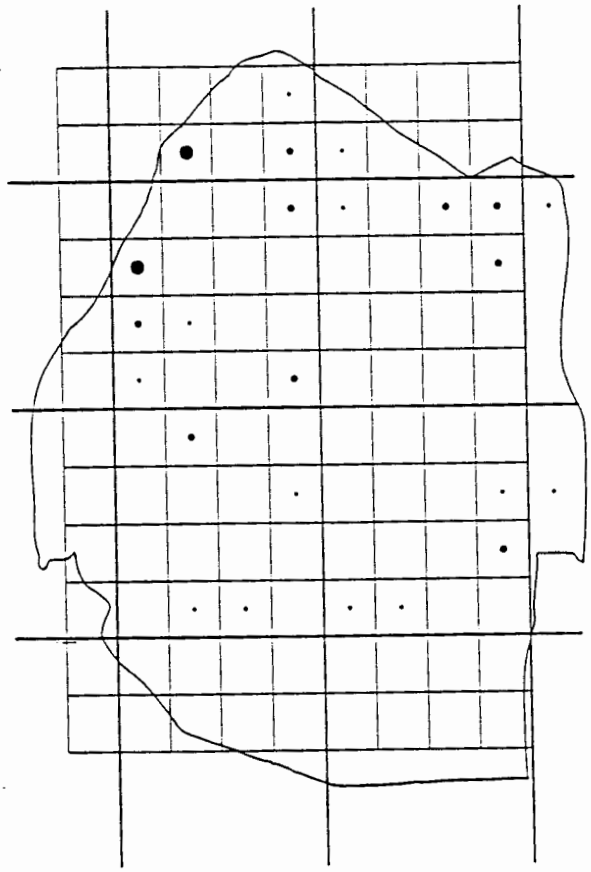
126. Black kite. (Milvus migrans)

Recording frequency: 2 (/2263).
Status: A rare summer migrant. During the early years of the fieldwork, no distinction was made between this and the previous species. It is therefore likely that this species is more common and widespread than indicated.



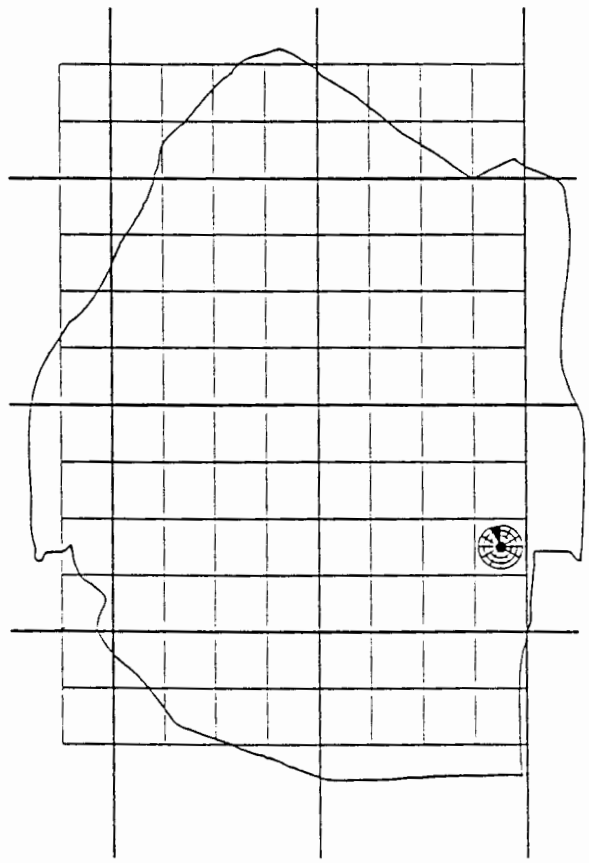
127. Blackshouldered kite. (Elanus caeruleus)

Recording frequency: 544 (/2263) 24%.
Population estimate: 800.
Status: A common breeding resident, though numbers fluctuate greatly from month to month in all regions.
Habitat preference: Woodland, savanna and grassland.



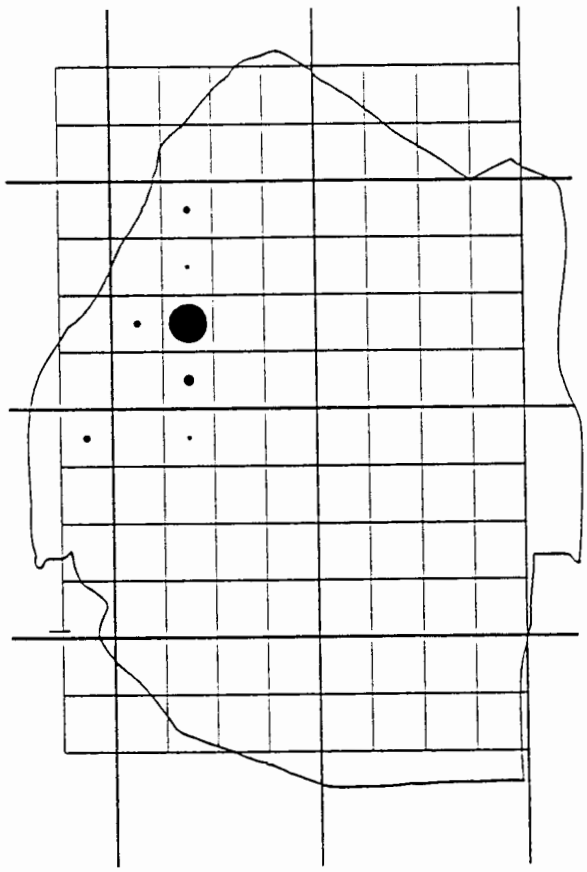
128. Cuckoo hawk. (Aviceda cuculoides)

Recording frequency: 40 (/2263) 2%.
Population estimate: 40.
Status: Uncommon resident (probably breeding).
Habitat preference: Woodland and forest, including wattle stands.



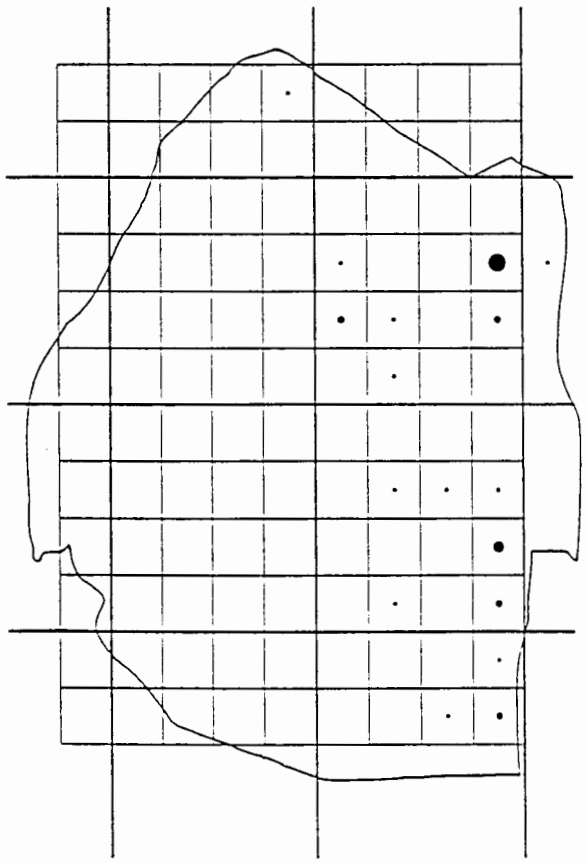
130. Honey buzzard. (Pernis apivorus)

A bird was seen near Big Bend (I11) in December 1991 (P. Rouse). (Subject to confirmation by the SAOS Rarities Committee.)



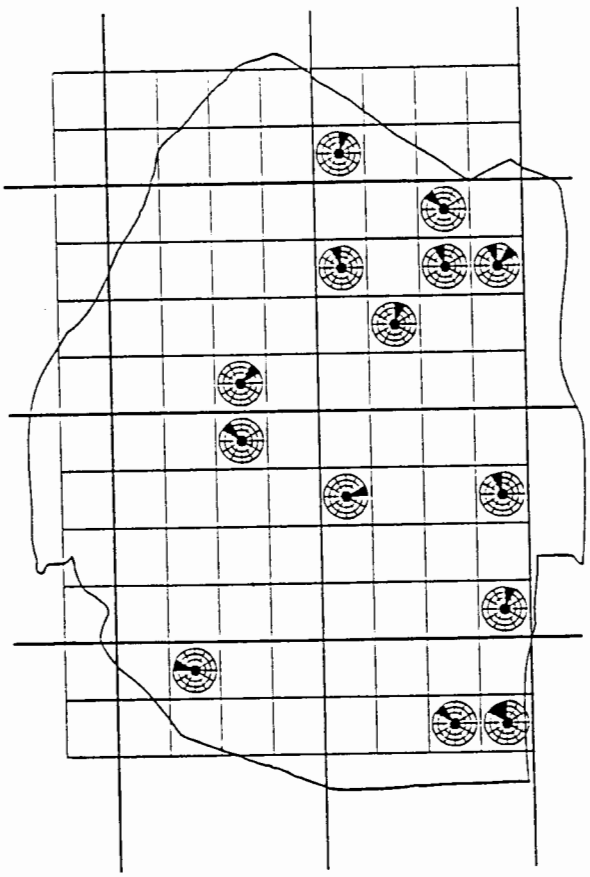
131. Black eagle. (Aquila verreauxii)

Recording frequency: 30 (/2263) 1%.
Population estimate: 14.
Status: A rare resident in the highveld, known to breed at Mbabane (E4) and Mlilwane (F4) and probably four or five other localities.
Habitat preference: Mountains and rocky outcrops.



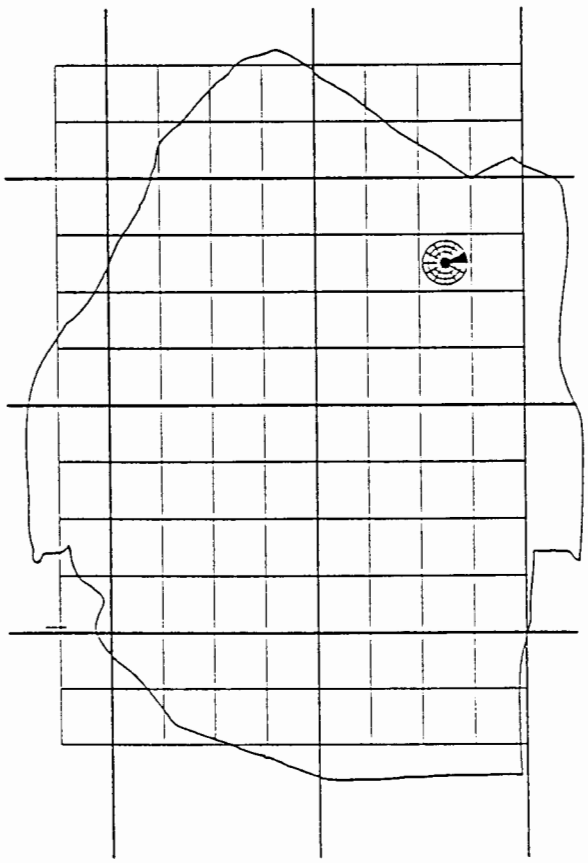
132. Tawny eagle. (Aquila rapax)

Recording frequency: 30 (/2263) 1%.
Population estimate: 40.
Status: An uncommon breeding resident in the lowveld.
Habitat preference: Woodland and savanna.



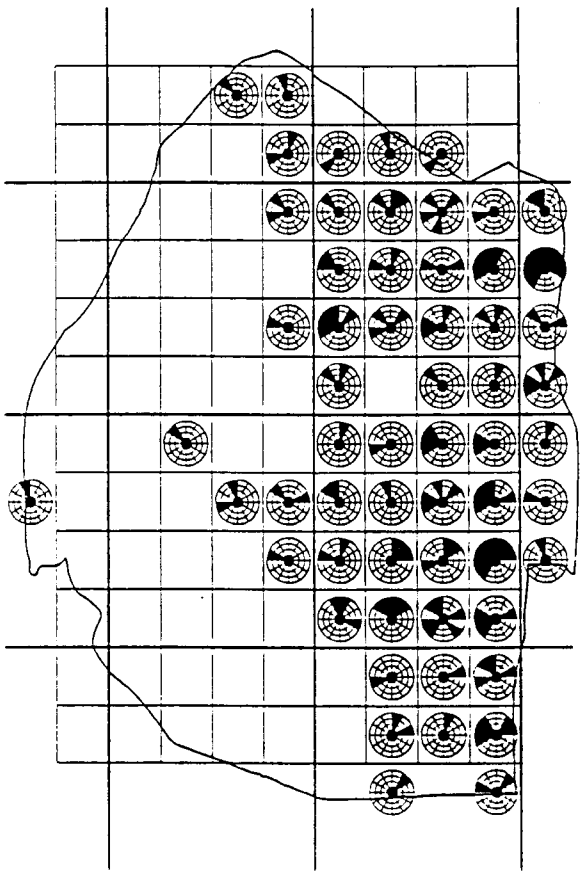
133. Steppe eagle. (Aquila nipalensis)

Recording frequency: 17 (/2263) 1%.
Status: An uncommon summer migrant in the lowveld and vagrant in the middleveld. Occurs singly or in flocks of up to 10 birds.
Habitat preference: Woodland and savanna.



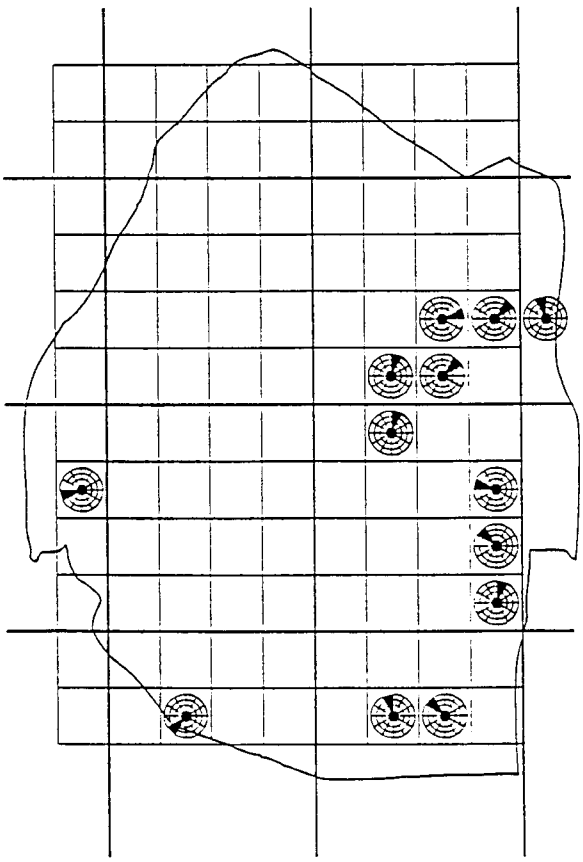
134. Lesser spotted eagle. (Aquila pomarina)

A bird was seen at Hlane (D9) in the lowveld in March 1988 (VP)



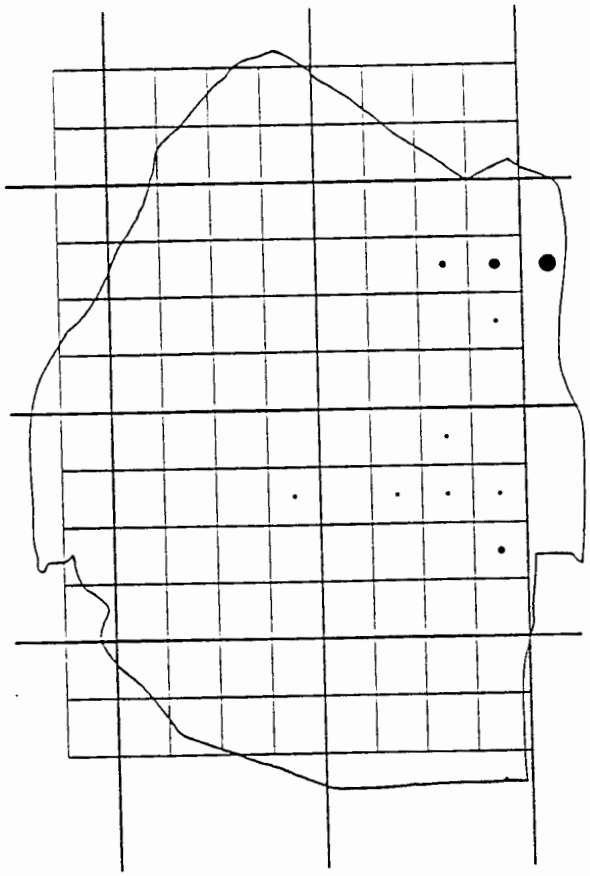
135. Wahlbergs eagle. (Aquila wahlbergi)

Recording frequency: 178 (/2263) 8%.
Population estimate: 200.
Status: A common breeding summer migrant in the lowveld.
Habitat preference: Forages in woodland and savanna. Nests are usually situated in riverine woodland.



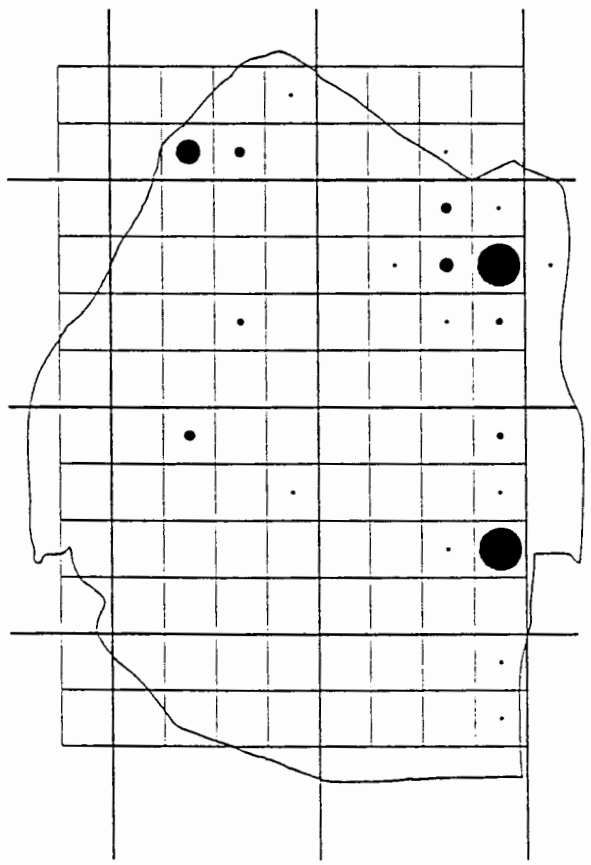
136. Booted eagle. (Hieraaetus pennatus)

Recording frequency: 14 (/2263) 1%.
Status: An uncommon summer migrant, encountered most often in the lowveld but also recorded in the southern highveld.
Habitat preference: Woodland, savanna, grassland and cultivated land.



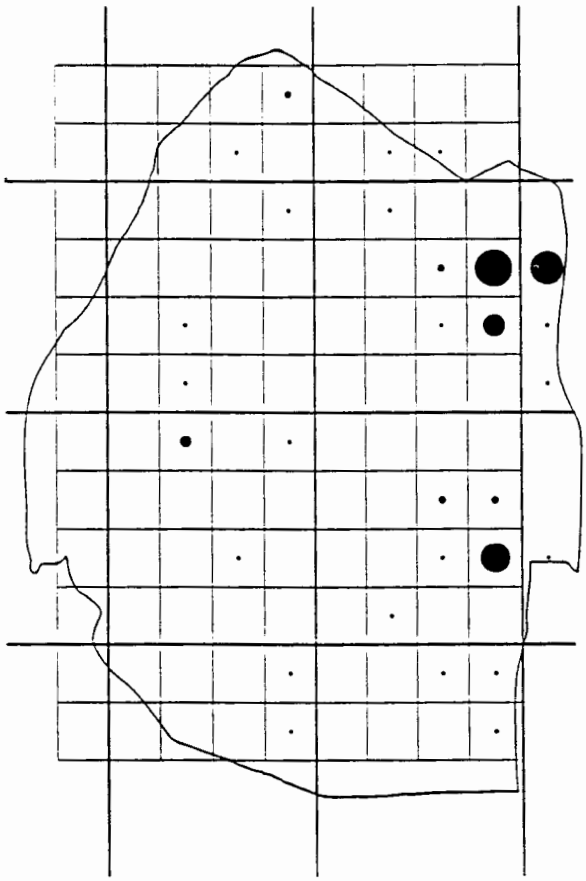
137. African hawk eagle. (Hieraaetus fasciatus)

Recording frequency: 19 (/2263) 1%.
Population estimate: 20.
Status: A rare resident in the lowveld, only encountered in areas where human disturbance is minimal. Breeding has been observed at Mlawula (D10) and probably occurs at a few other localities.
Habitat preference: Woodland and savanna, usually nesting in riverine woodland.



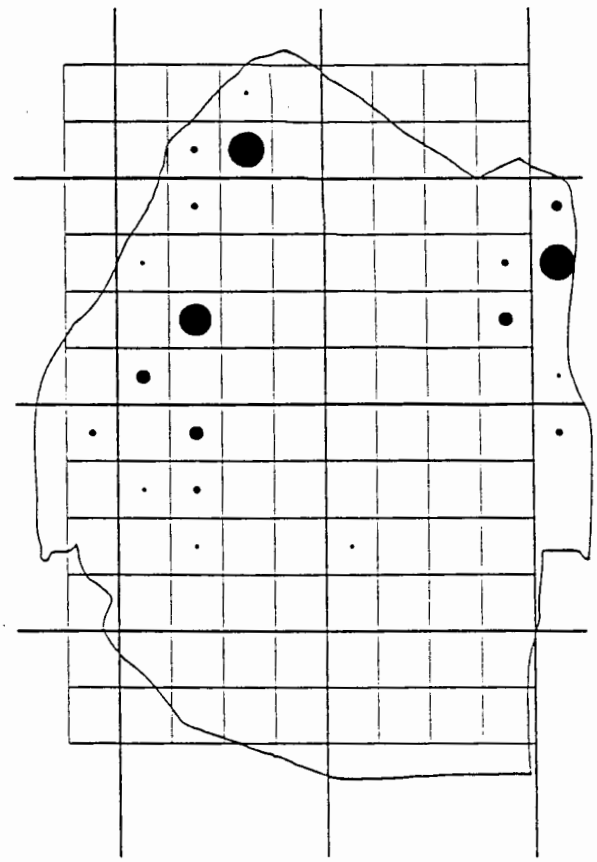
139. Longcrested eagle. (Lophaetus occipitalis)

Recording frequency: 123(/2263) 5%.
Population estimate: 40.
Status: An uncommon breeding resident in the lowveld and middleveld and vagrant in the highveld. Breeding has been observed at Tambankulu (C10) and at Big Bend (I10).
Habitat preference: Woodland and cultivated lands.



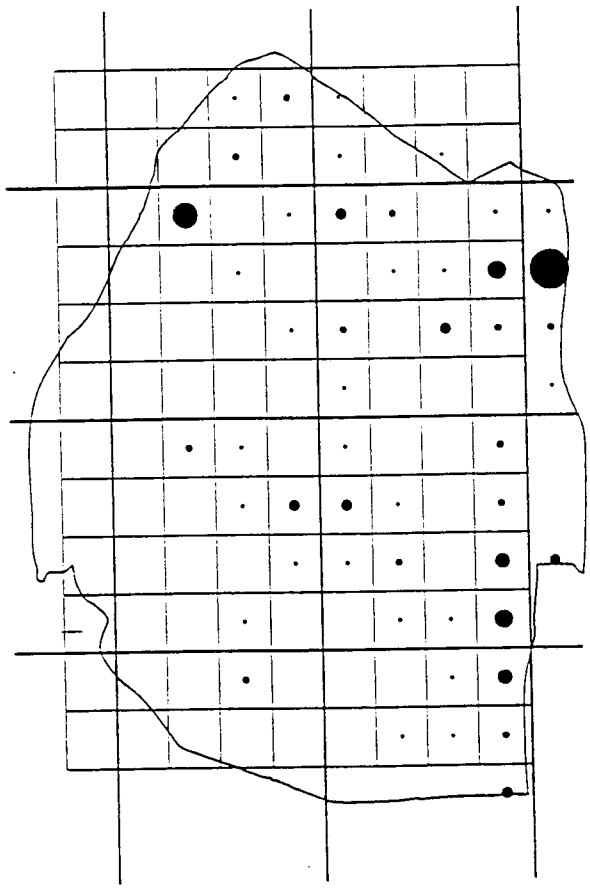
140. Martial eagle. (Polemaetus bellicosus)

Recording frequency: 74 (/2263) 3%.
Population estimate: 40.
Status: A rare breeding resident in the lowveld and middleveld. Breeding has been observed at Mkhaya (H9) and Big Bend (I10).
Habitat preference: Savanna.



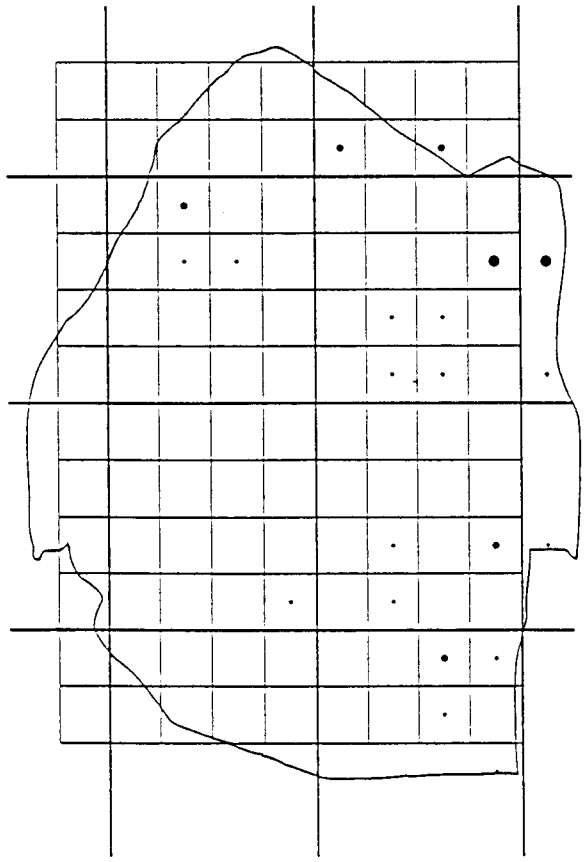
141. Crowned eagle. (Stephanoaetus coronatus)

Recording frequency: 83 (/2263) 4%.
Population estimate: 60.
Status: An uncommon breeding resident in the highveld, middleveld and Lubombos. Breeding has been observed at Mbabane (E4) and at Mlawula (D11).
Habitat preference: Forest.



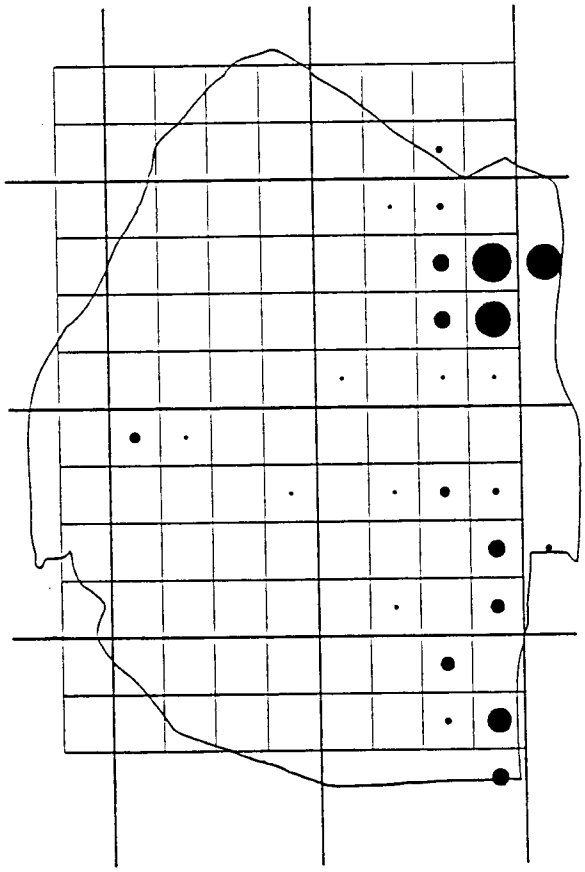
142. Brown snake eagle. (Circaetus cinereus)

Recording frequency: 112 (/2263) 5%.
Population estimate: 100.
Status: An uncommon breeding resident in the middleveld, lowveld and Lubombos. Nests have been observed at Big Bend (I10) and Balegane (C7). Whereas in the Transvaal the population of this species is apparently subject to influxes of non breeding birds (Tarboton and Allan) in Swaziland the population appears fairly constant throughout the year.
Habitat preference: Woodland and savanna.



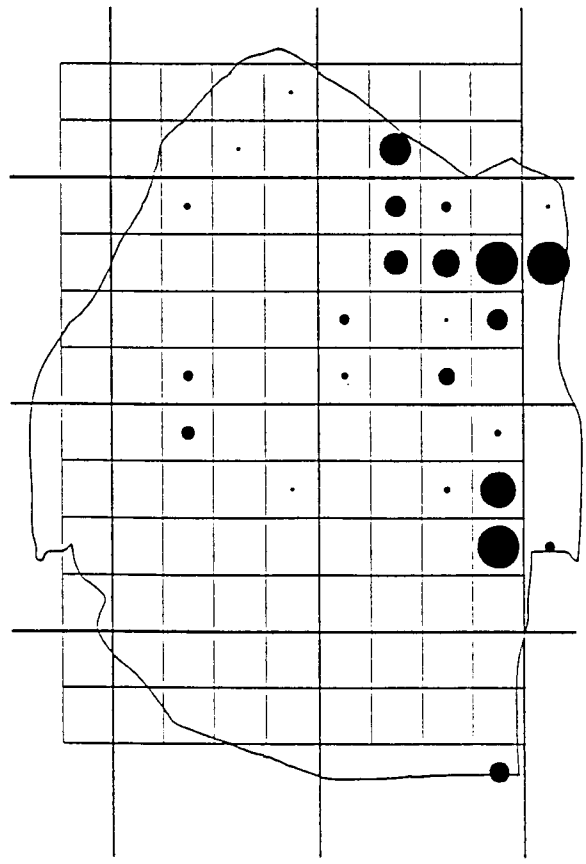
143. Blackbreasted snake eagle. (Circaetus gallicus)

Recording frequency: 31 (/2263) 1%.
Population estimate: 10.
Status: A rare resident (probably breeding) in the middleveld, lowveld and Lubombos.
Habitat preference: Grassland and savanna.



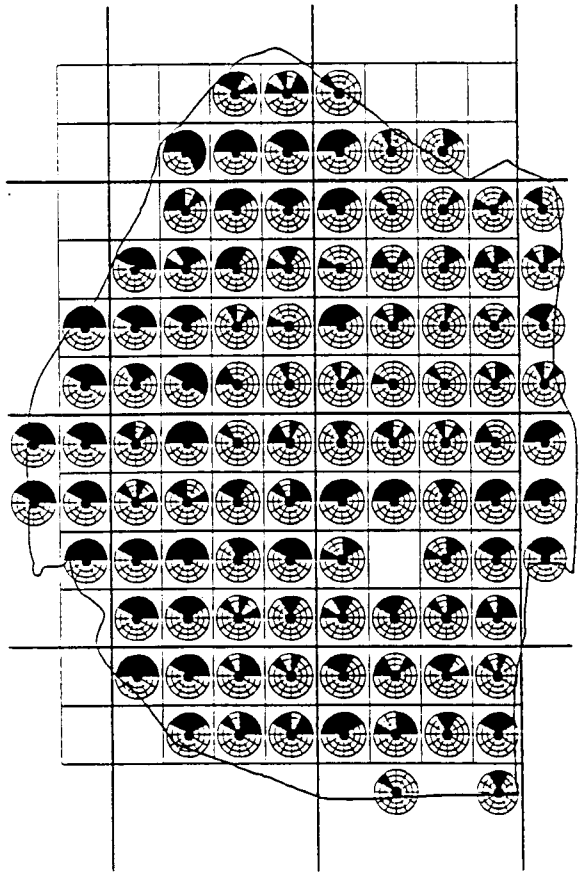
146. Bateleur. (Terathopius ecaudatus)

Recording frequency: 128(/2263) 6%.
Population estimate: 50.
Status: A rare breeding resident in the lowveld, though one pair is resident near Bhunye (G3) in the middleveld. Breeding has been observed at Big Bend (I10) and at Mkhaya (H7). The species used to be far more common in the lowveld before 1970 (J. Culverwell, R.Harding, pers. comm.), but is now confined to areas of minimal human activity. Possible causes for the decline of the species are discussed in the Swaziland Red Data Book: Birds by V. Parker.
Habitat preference: Savanna and woodland.



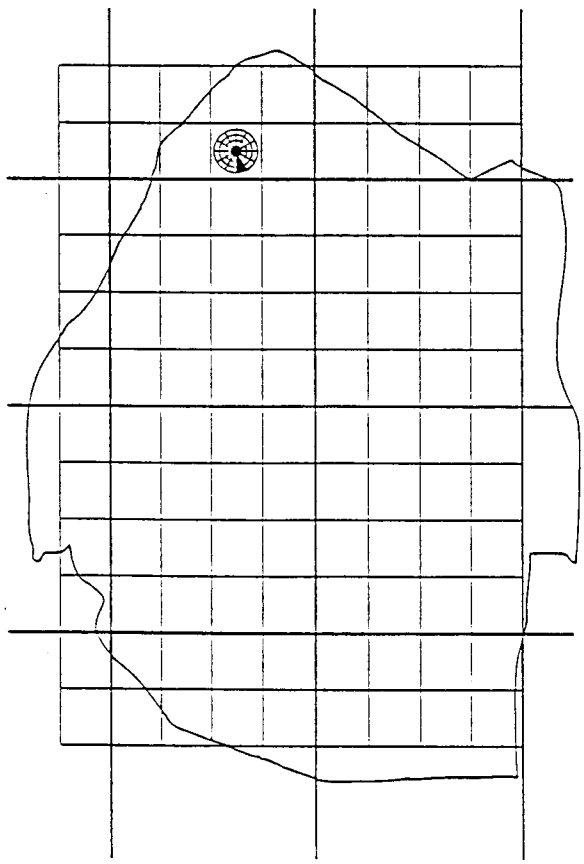
148. African fish eagle. (Haliaeetus vocifer)

Recording frequency: 236 (/2263) 10%.
Population estimate: 20.
Status: A rare resident. Breeding has been observed repeatedly at Big Bend (I10) and Sand River Dam (C8).
Habitat preference: Large dams and rivers.



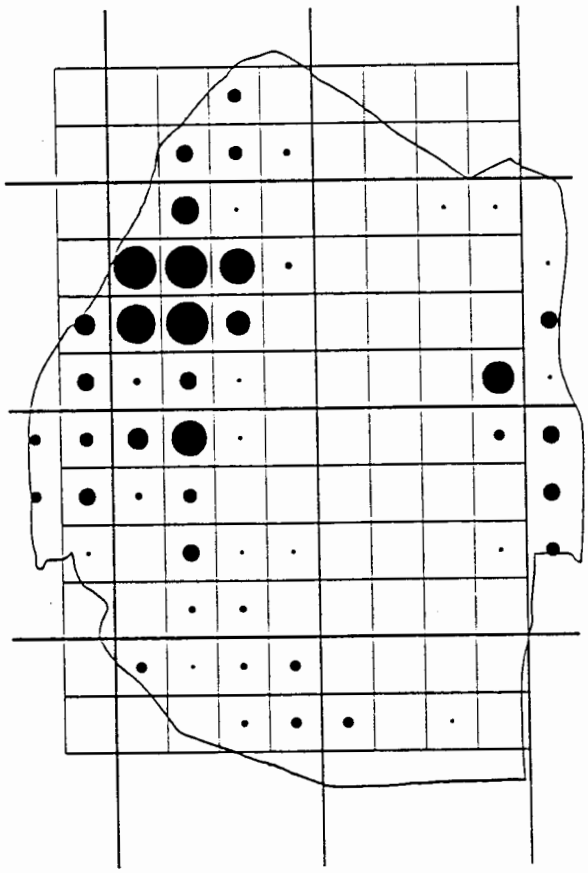
149. Steppe buzzard. (Buteo buteo)

Recording frequency: 449 (/2263) 20%.
Status: A very common summer migrant.
Habitat preference: Encountered in all habitat types. Departs from the lowveld during February and from the highveld during March, when flocks of up to 50 birds have been seen on migration. Encountered singly at other times.



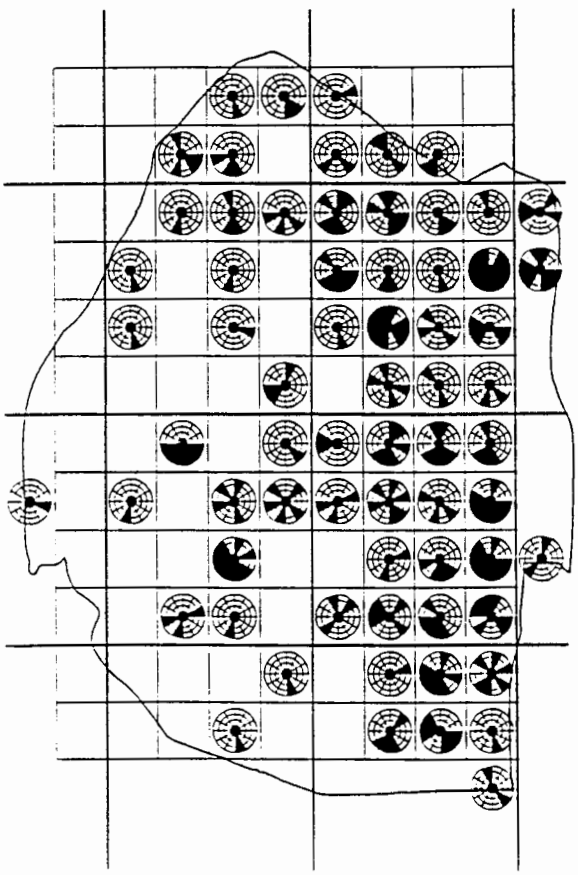
150. Forest buzzard. (Buteo oreophilus)

Recording frequency: 1 (/2263) 0,05%.
Population estimate: 4.
A bird was seen near Piggs Peak (B4) in the north west in June 1990 (J. Brown). (Ratified by the SAOS Rarities Committee). There have been other unconfirmed sightings in the area.



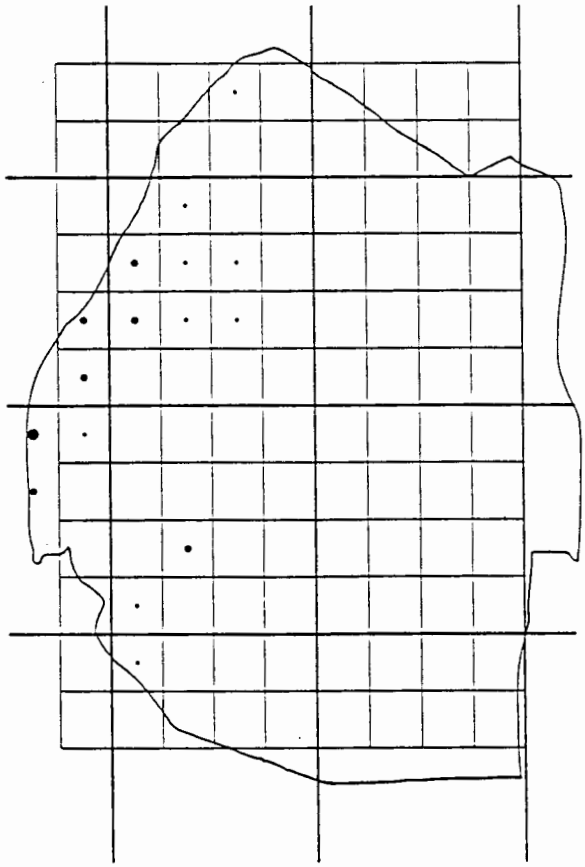
152. Jackal buzzard. (Buteo rufofuscus).

Recording frequency: 309 (/2263) 14%.
Population estimate: 300.
Status: A common breeding resident in the highveld and Lubombos.
Habitat preference: Open, mountainous country.



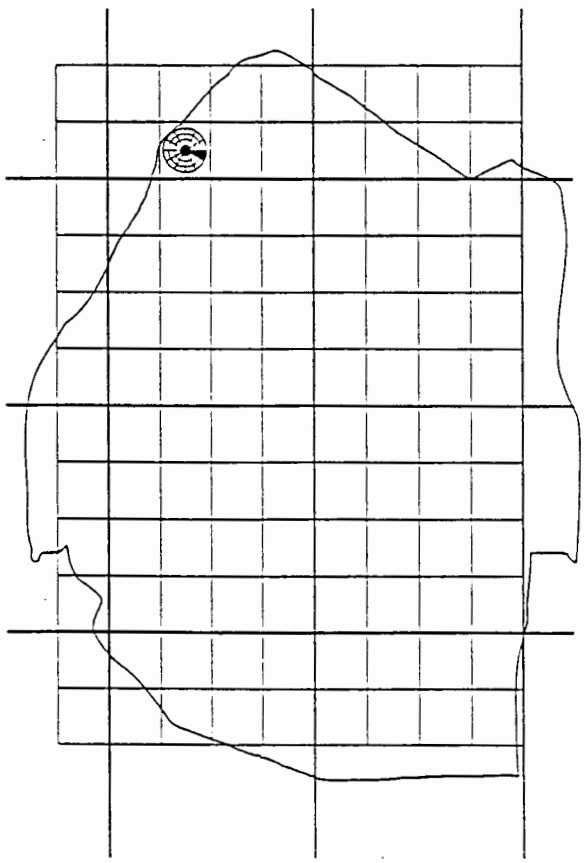
154. Lizard buzzard. (Kaupifalco monogrammicus)

Recording frequency: 269 (/2263) 12%.
Population estimate: 600.
Status: An uncommon resident in the lowveld and Lubombos and winter visitor to the highveld and middleveld. Although breeding has not been observed, birds were frequently observed performing aerial displays and calling during the winter months in the lowveld and it is probable that the species does breed there. The lowveld population appears to be fairly constant and is apparently not subject to the seasonal and yearly fluctuations which are reported for the population in the Transvaal lowveld. (Tarboton and Allan). The species was unusually common in the highveld during the winter of 1992, after completion of data collection for the atlas.
Habitat preference: Woodland and savanna.



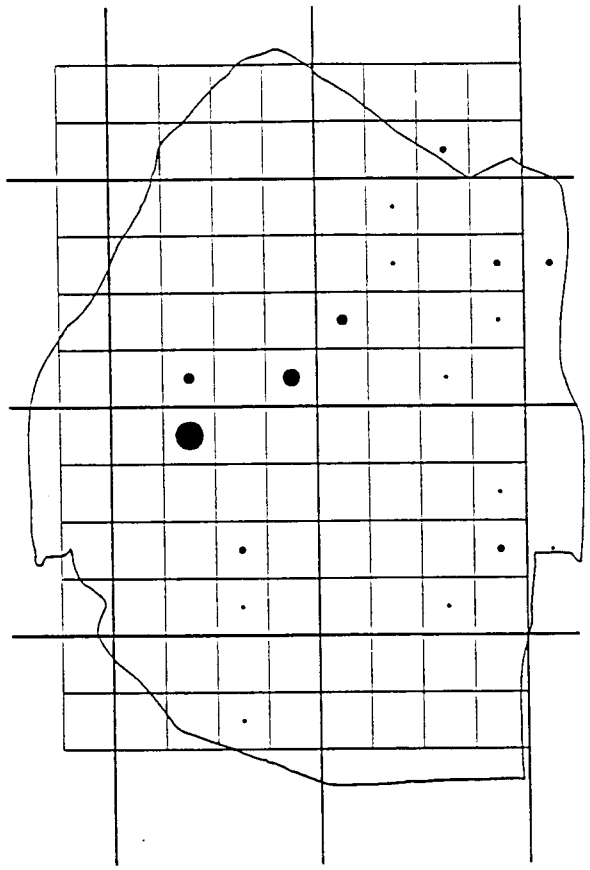
155. Redbreasted sparrowhawk. (Accipiter rufiventris)

Recording frequency: 24 (/2263) 1%.
Population estimate: 60.
Status: An uncommon breeding resident in the highveld.
Habitat preference: Forages over highveld grasslands and nests in forests and timber plantations.



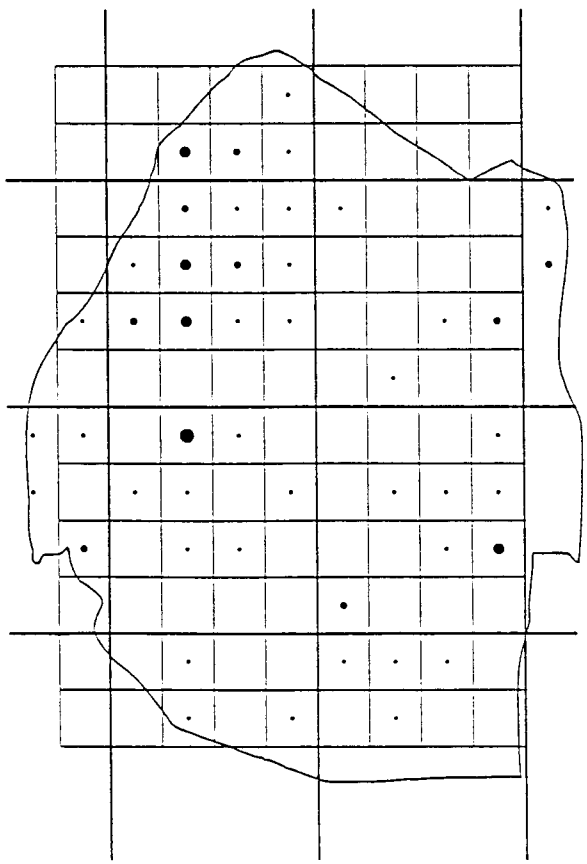
156. Ovambo sparrowhawk. (Accipiter ovampensis)

Recording frequency: 1 (/2263) 0,05 %.
One bird was seen at Bulembu (B4) in April 1987 (VP)



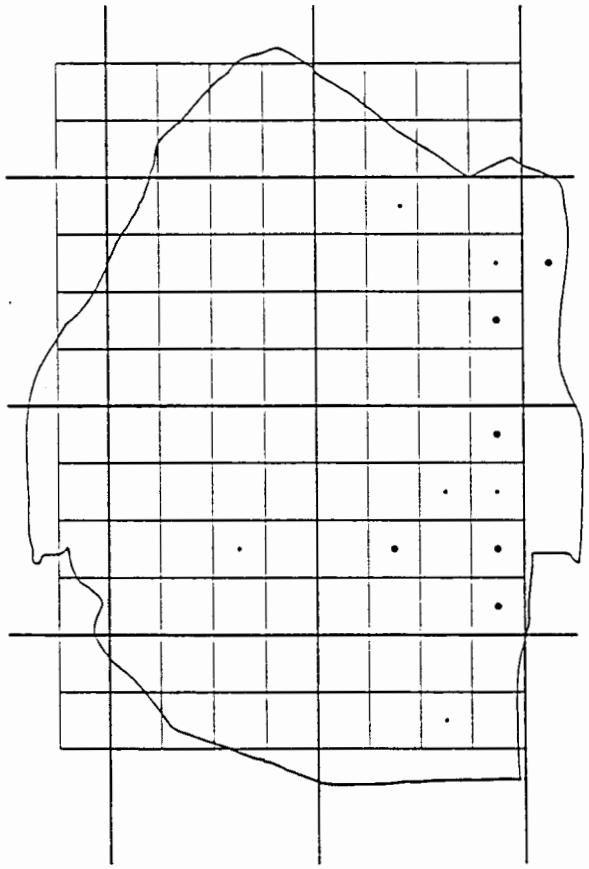
157. Little sparrowhawk. (Accipiter minullus)

Recording frequency: 44 (/2263) 2%.
Population estimate: 100.
Status: Uncommon breeding resident. Since it is very unobtrusive, it is probably more widespread and common than the distribution map indicates.
Habitat preference: Woodland and savanna.



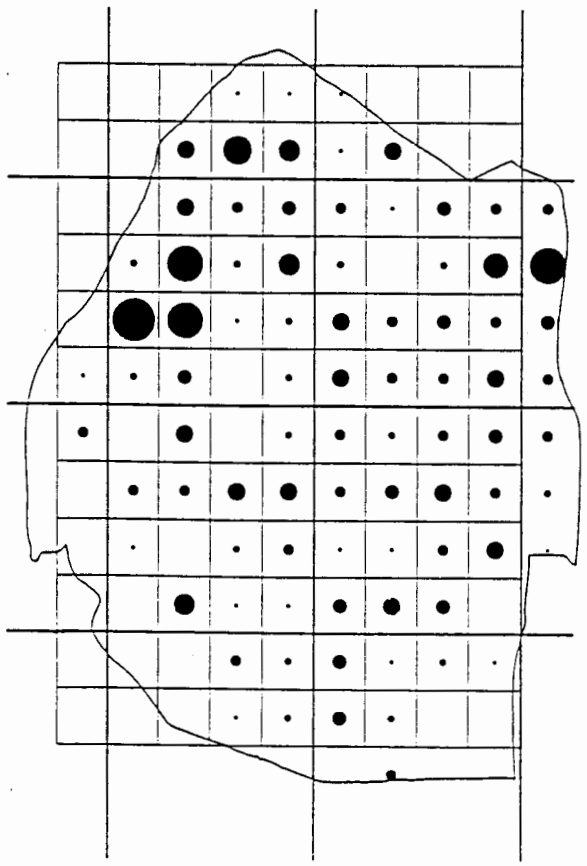
158. Black sparrowhawk. (Accipiter melanoleucus)

Recording frequency: 68 (/2263) 3%.
Population estimate: 200.
Status: Uncommon breeding resident.
Habitat preference: Mostly confined to woodland but occasionally forages in open country.



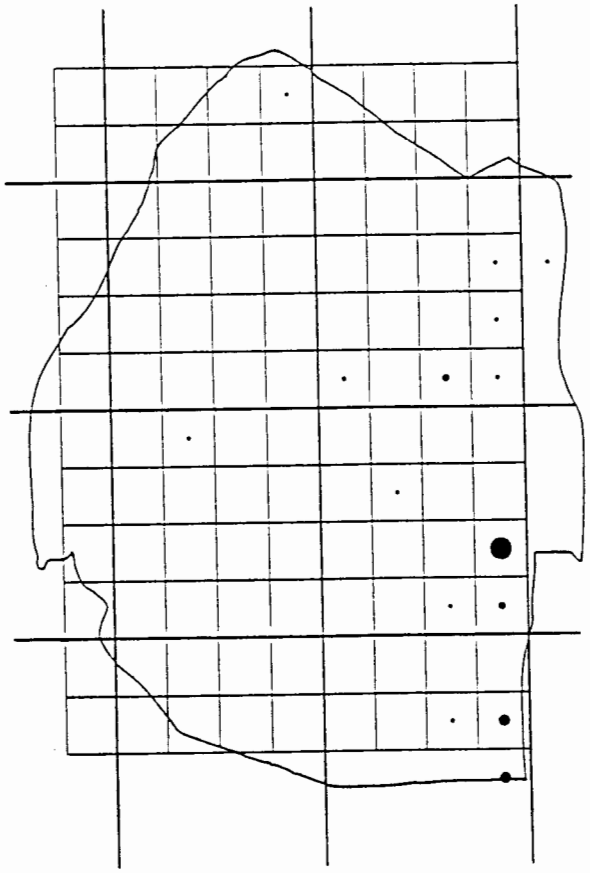
159. Little banded goshawk. (Accipiter badius)

Recording frequency: 19 (/2263) 1%.
Population estimate: 40.
Status: Uncommon breeding resident in the lowveld and vagrant in the highveld. Since it is very unobtrusive it is probably more widespread and common than its distribution map and recording rate indicate.
Habitat preference: Woodland, savanna and cultivated lands.



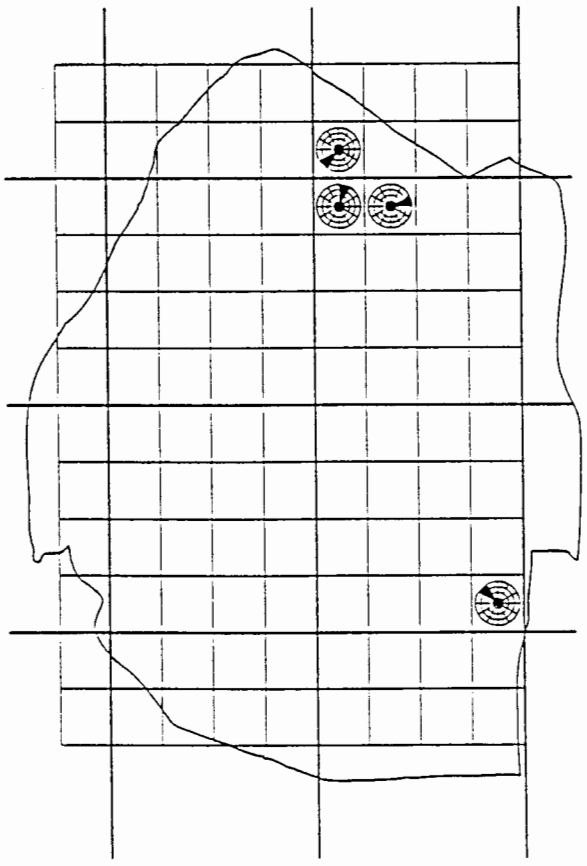
160. African goshawk. (Accipiter tachiro)

Recording frequency: 340(/2263) 15%.
Population estimate: 400.
Status: Common breeding resident.
Habitat preference: Woodland, forest and wattle stands.



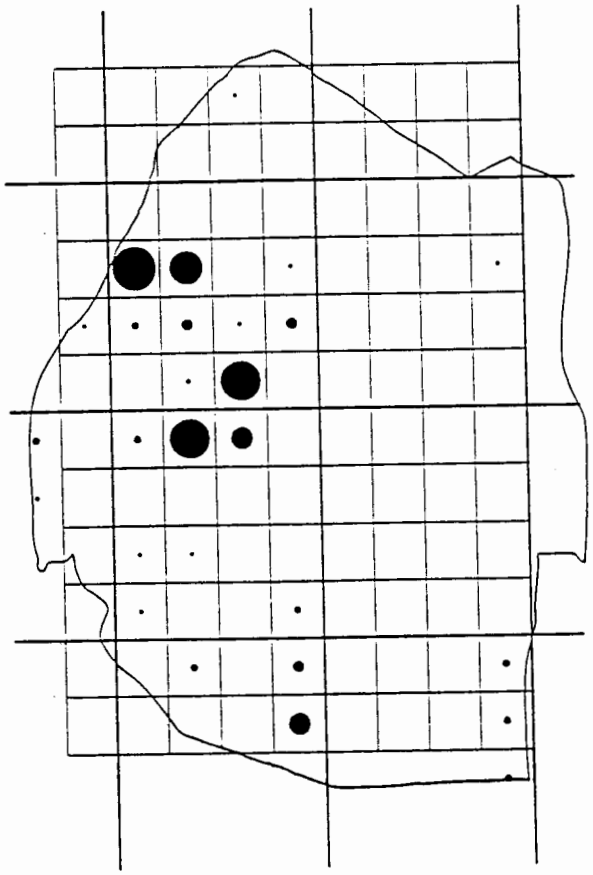
161. Gabar goshawk. (Micronisus gabar)

Recording frequency: 28 (/2263) 1%.
Population estimate: 40.
Status: Uncommon breeding resident in the lowveld and vagrant in the middleveld. In the south, between Lavumisa (M10) and Nsoko (K10), the melanistic form is encountered more often than the pale form.
Habitat preference: Thorn savanna.



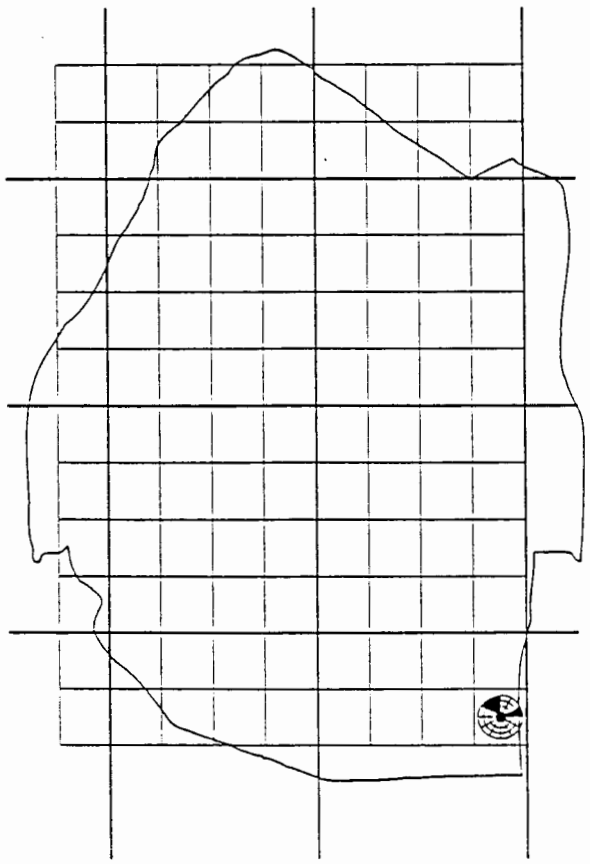
163. Dark chanting goshawk. (Melierax metabates)

Recording frequency: 4 (/2263) 0,20%.
Status: Uncommon visitor in the north western lowveld and vagrant further south.
Habitat preference: Usually encountered at the roadside in woodland.



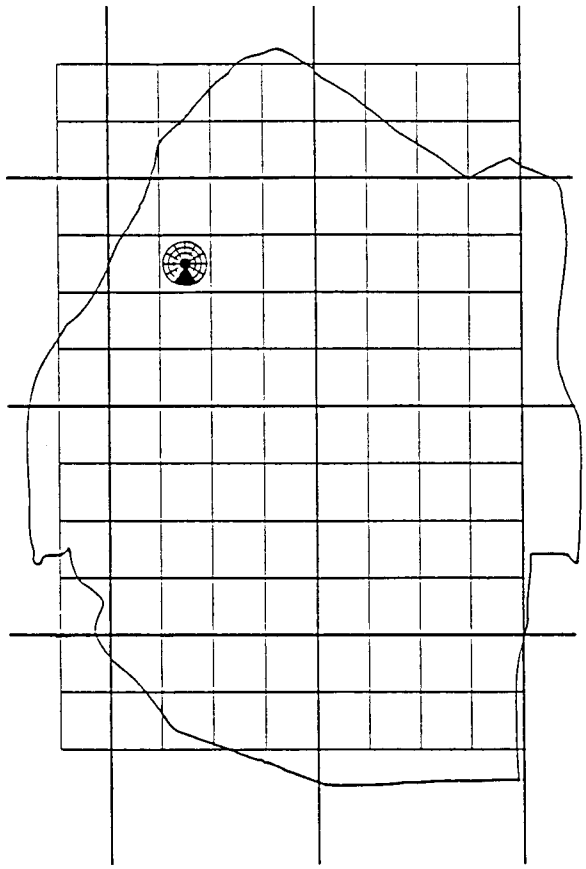
165. African marsh harrier. (Circus ranivorus)

Recording frequency: 140 (/2263) 6%.
Population estimate: 100.
Status: Uncommon breeding resident in the highveld and middleveld, uncommon visitor to the southern lowveld and vagrant to the northern lowveld.
Habitat preference: Vleis.



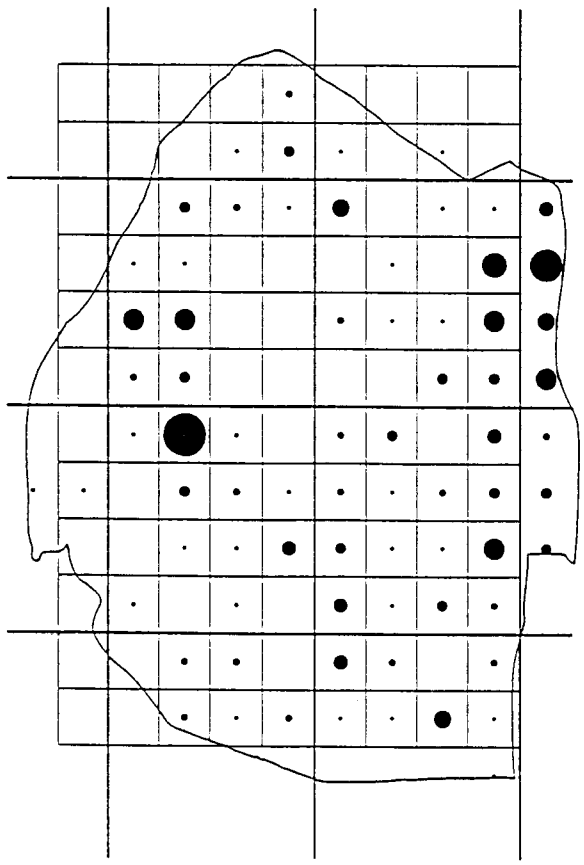
166. Montagu's harrier. (Circus pygargus)

Recording frequency: 3 (/2263) 0,15%.
Status: Rare summer migrant. A group of up to 10 birds was encountered in three successive summers at the same locality, among cotton and hay fields near Nsoko (L10).



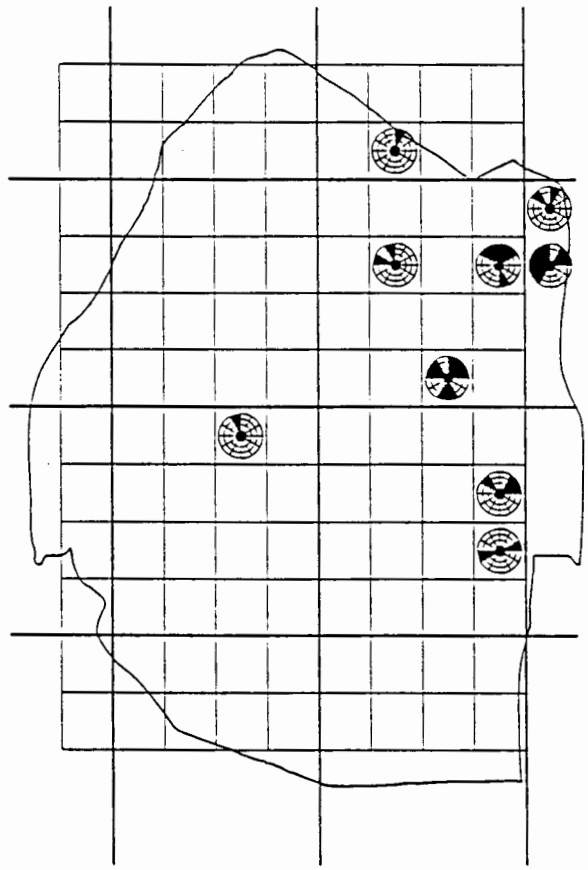
168. Black harrier (Circus maurus).

A single adult was seen at Malolotja (D4) in July 1986 (T. Ballance) and at the same locality in June (R. Boycott) and July 1992 (VP).

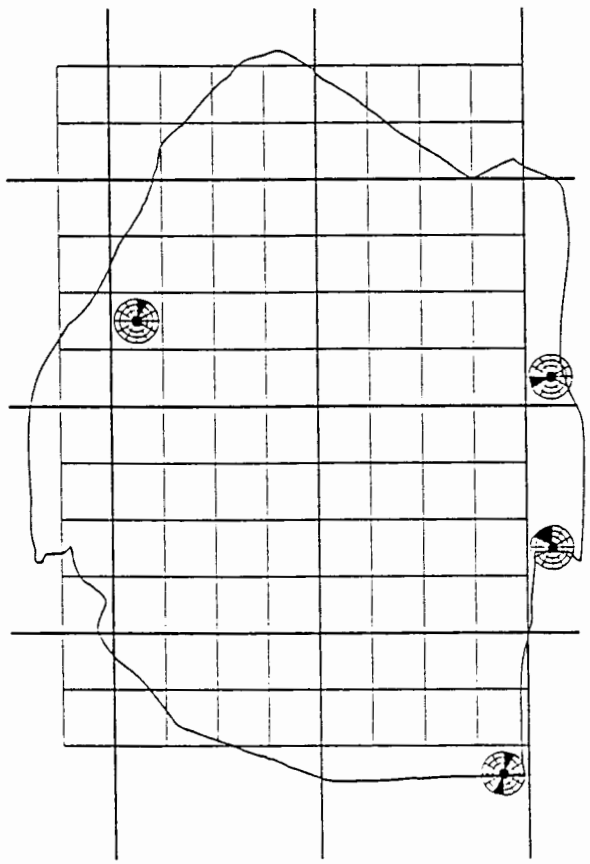


169. Gymnogene. (Polyboroides typus)

Recording frequency: 248 (/2263) 11%.
Population estimate: 200.
Status: Uncommon breeding resident.
Habitat preference: Encountered in all wooded habitats, but most often in woodland.

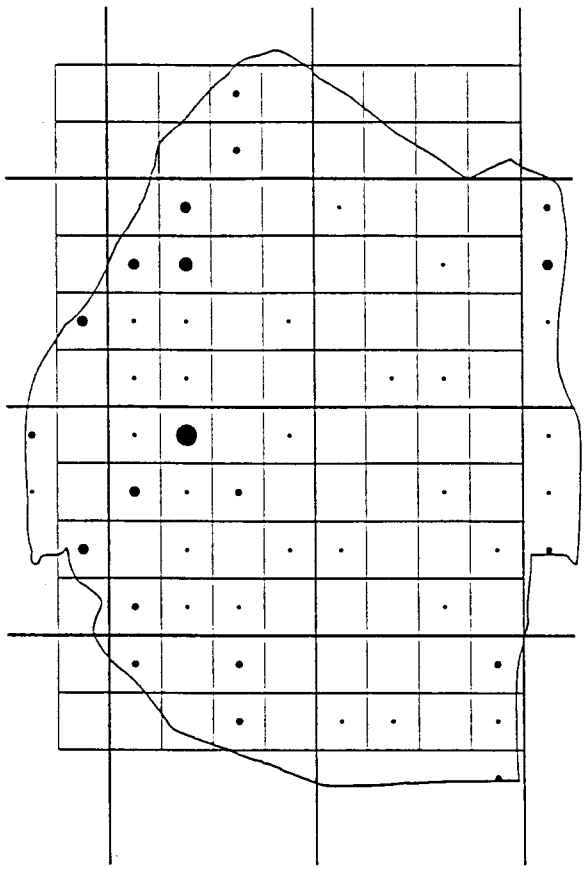


170. Osprey. (Pandion haliaetus)
Recording frequency: 35 (/2263) 2%.
Status: Rare summer migrant.
Habitat preference: Dams and rivers.



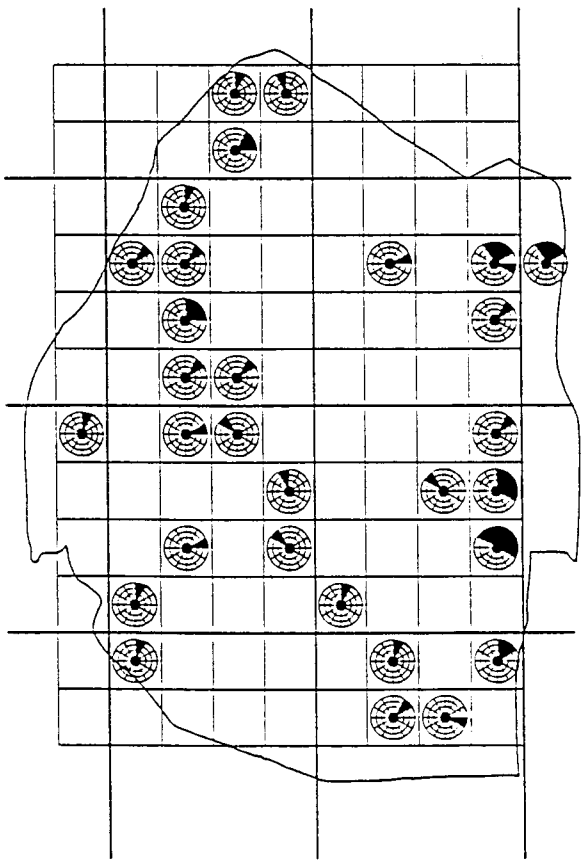
171. Peregrine falcon. (Falco peregrinus)

Recording frequency: 7 (/2263) 0,35%.
Population estimate: 10.
Status: Rare breeding resident in the Lubombos and vagrant or rare summer migrant in the highveld.
Habitat preference: Forested river gorges with cliffs.



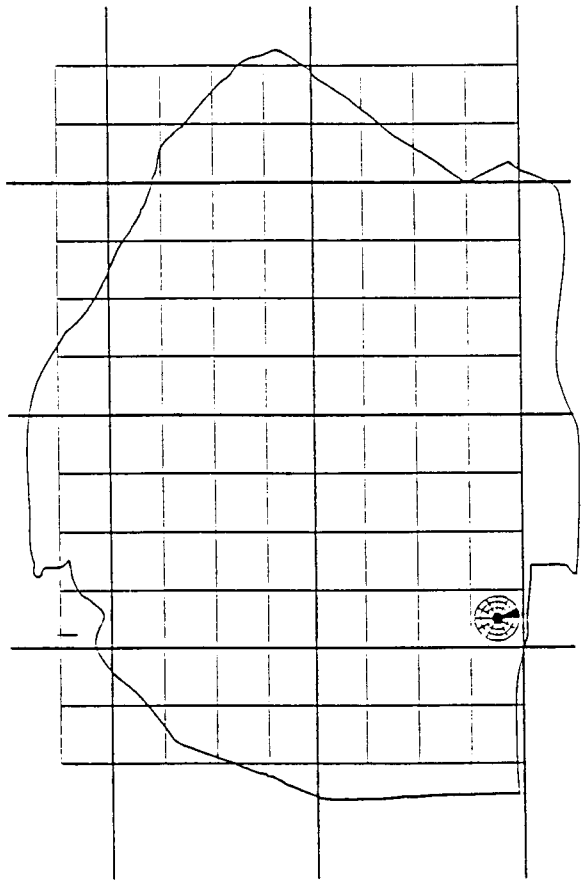
172. Lanner falcon. (Falco biarmicus)

Recording frequency: 83 (/2263) 4%.
Population estimate: 200.
Status: Common breeding resident in the highveld and uncommon elsewhere.
Habitat preference: Encountered in all habitats.



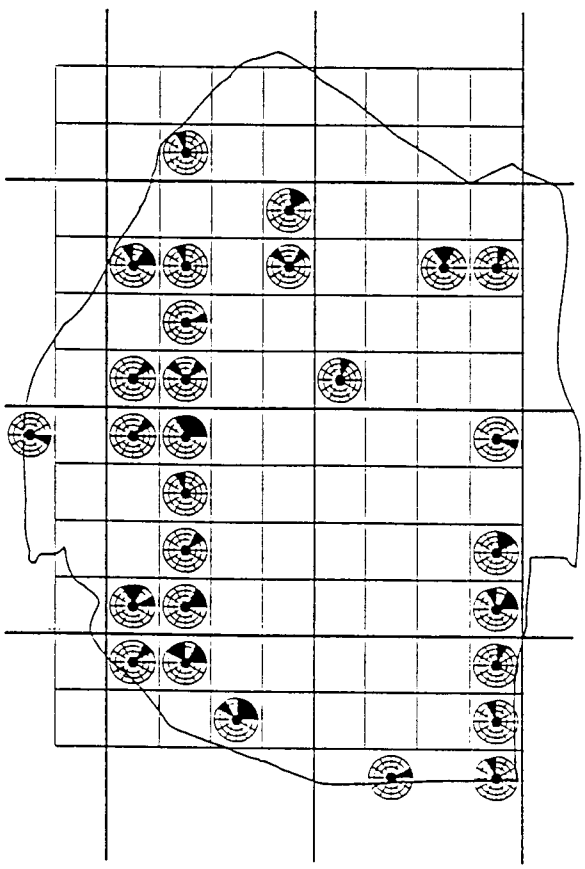
173. Hobby falcon. (Falco subbuteo)

Recording frequency: 53 (/2263) 2%.
Status: Uncommon summer migrant.
Habitat preference: Encountered in all habitats.



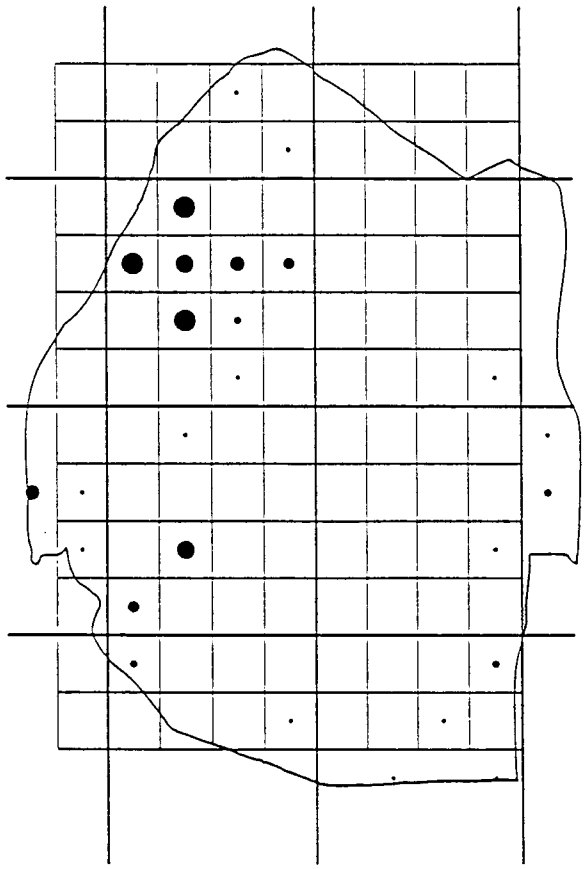
179. Western redfooted kestrel. (Falco vespertinus)

Recording frequency: 1 (/2263) 0,05%.
A bird was seen near Big Bend (J10) in March 1990 (VP).



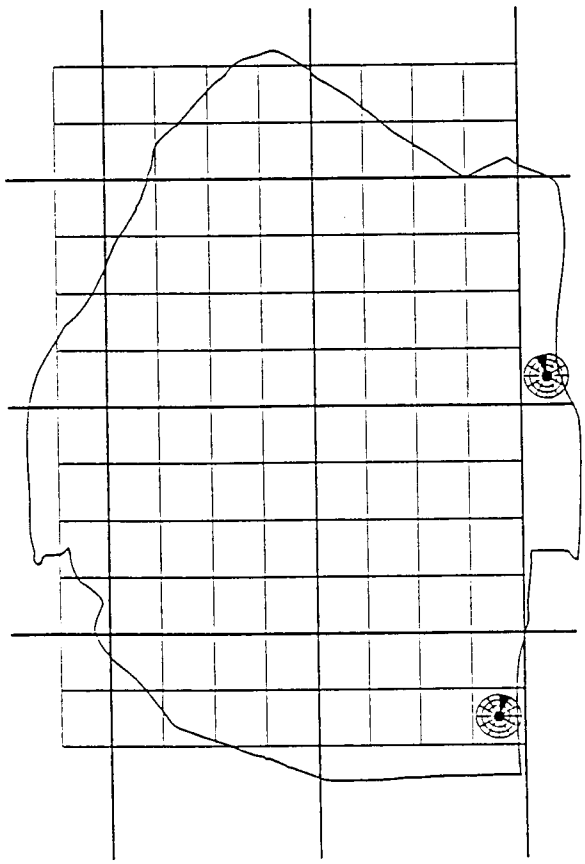
180. Eastern redfooted kestrel. (Falco amurensis)

Recording frequency: 66 (/2263) 3%.
Status: Uncommon summer migrant.
Habitat preference: Savanna and grassland. Encountered in small flocks of up to 10 birds.



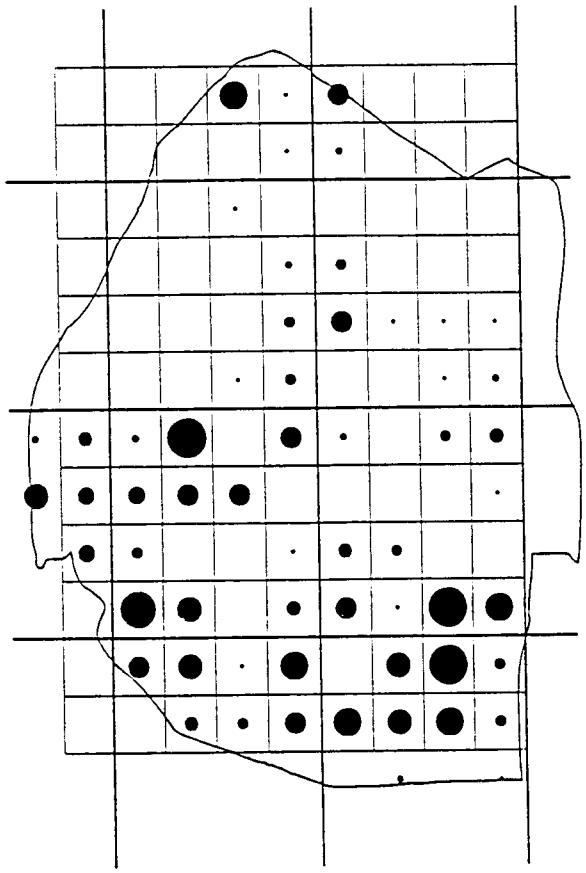
181. Rock kestrel. (Falco tinnunculus)

Recording frequency: 71 (/2263) 3%.
Population estimate: 100.
Status: Uncommon breeding resident in the highveld and the southern part of the Lubombos.
Habitat preference: Open country in mountainous areas.



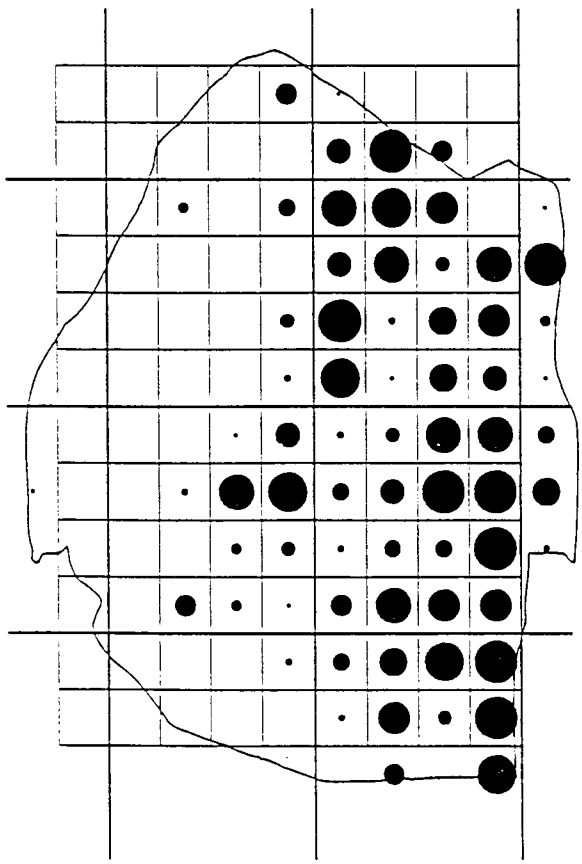
183. Lesser kestrel. (Falco naumanni)

Recording frequency: 2 (/2263) 0,1%.
A bird was seen near Nsoko (K10) in January 1989 (VP) and another near Sitsatsaweni (F11) in December 1991 (VP).



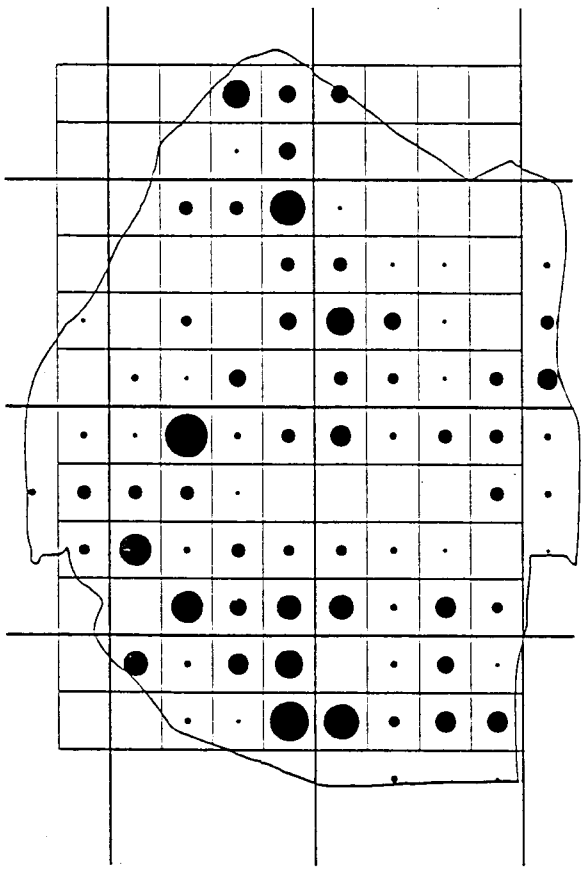
188. Coqui francolin. (Francolinus coqui)

Recording frequency: 267 (/2263) 12%.
Population estimate: 600.
Status: Uncommon breeding resident in the southern highveld, middleveld and southern lowveld.
Habitat preference: Grassland and savanna.



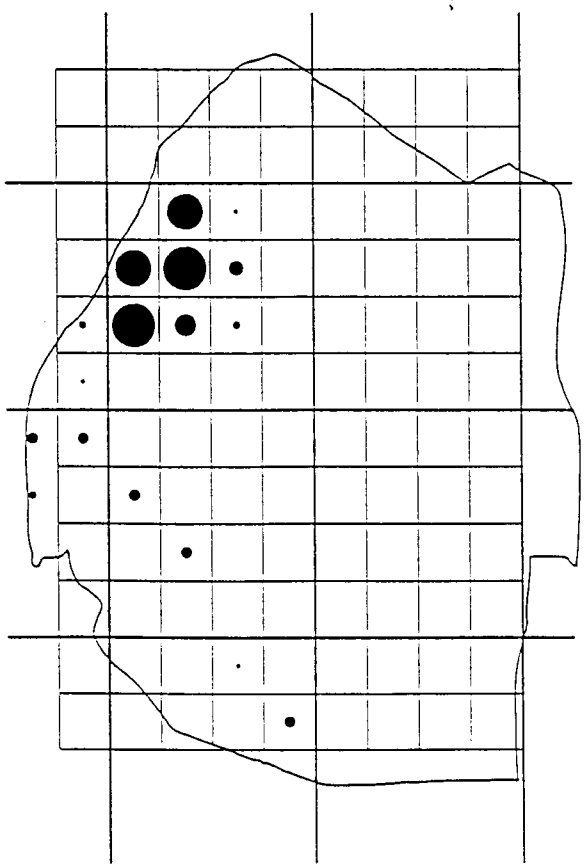
189. Crested francolin. (Francolinus sephaena)

Recording frequency: 609 (/2263) 27%.
Population estimate: 2 000.
Status: A breeding resident, common in the lowveld and uncommon in the middleveld and Lubombos.
Habitat preference: Savanna and woodland.



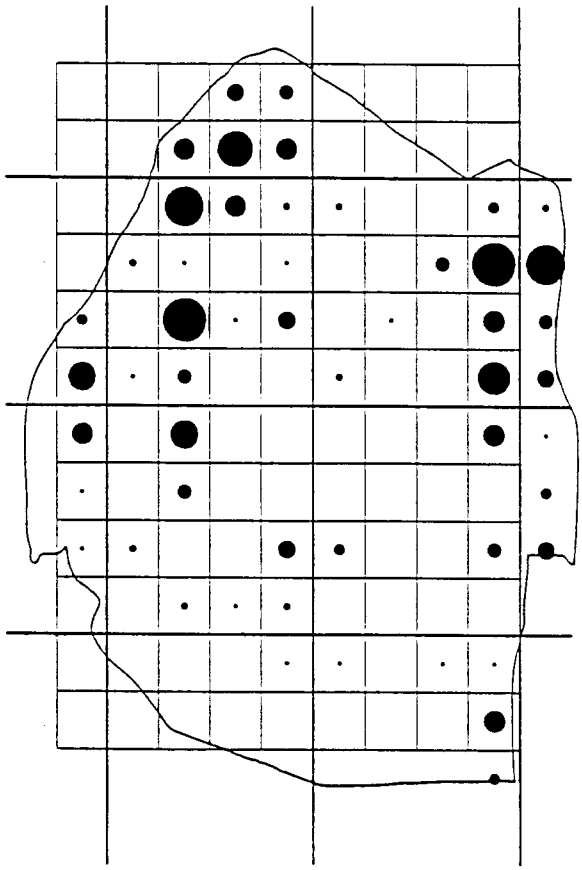
191. Shelley's francolin. (Francolinus shelleyi)

Recording frequency: 342 (/2263) 15%.
Population estimate: 800.
Status: A common breeding resident in most regions, but absent from the higher parts of the highveld and the more heavily wooded parts of the lowveld.
Habitat preference: Grassland and savanna.



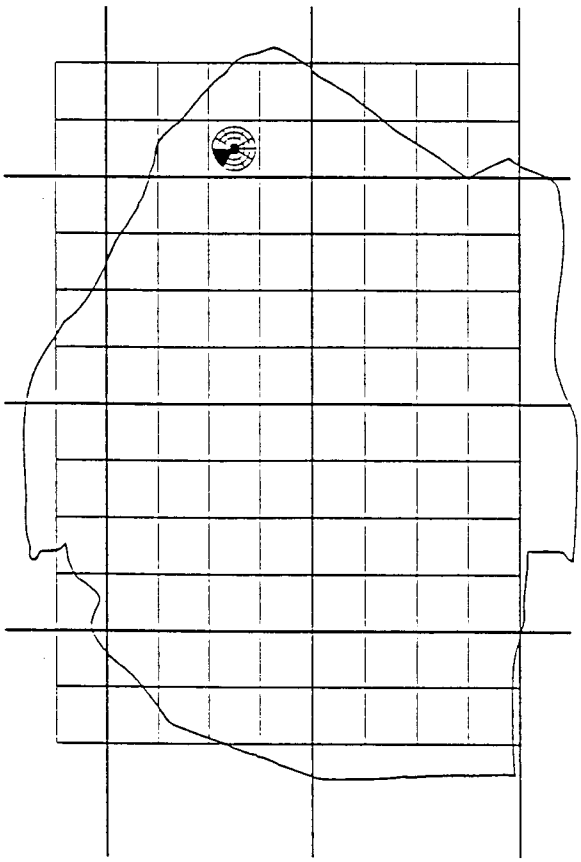
192. Redwing francolin. (Francolinus levaillantoides)

Recording frequency: 118 (/2263) 5%.
Population estimate: 400.
Status: A breeding resident in the highveld, common in the higher parts and uncommon elsewhere.
Habitat preference: Highveld grassland.



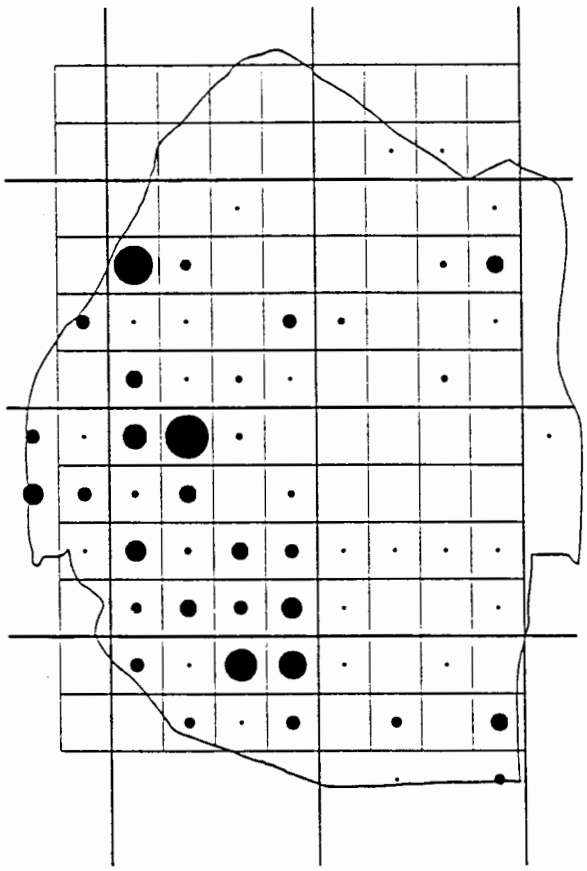
196. Natal francolin. (Francolinus natalensis)

Recording frequency: 293 (/2263) 13%
Population estimate: 600.
Status: A common breeding resident in heavily wooded areas.
Habitat preference: Woodland.



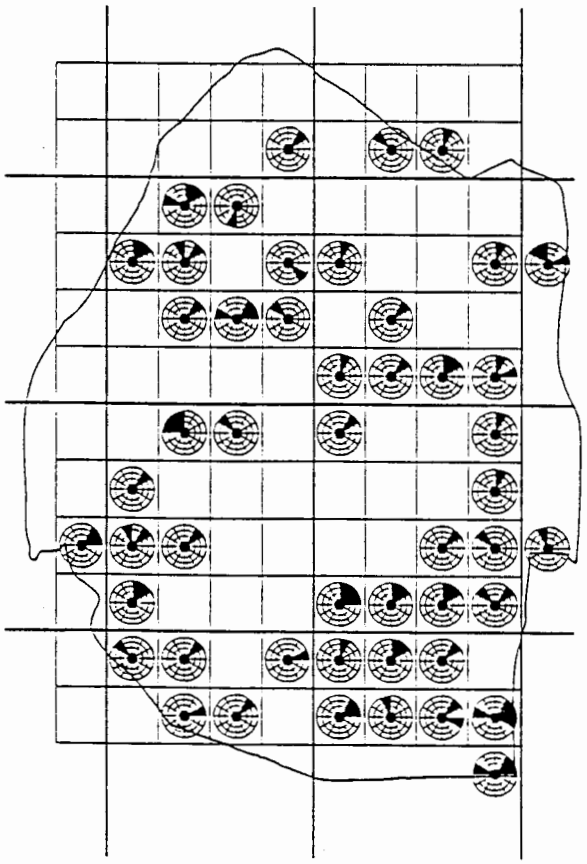
198. Rednecked francolin. (Francolinus afer)

Recording frequency: 2 (/2263) 0,1 %.
Population estimate: 10.
Status: The species is probably a breeding resident on the slopes of Umkhobolondo mountain (B5) and possibly at Mlilwane (F4) in the middleveld where its presence is subject to confirmation. Possibly overlooked at other localities due to its similarity to Swainson's francolin, especially with respect to vocalisation.
Habitat preference: Montane grassland/forest mosaic.



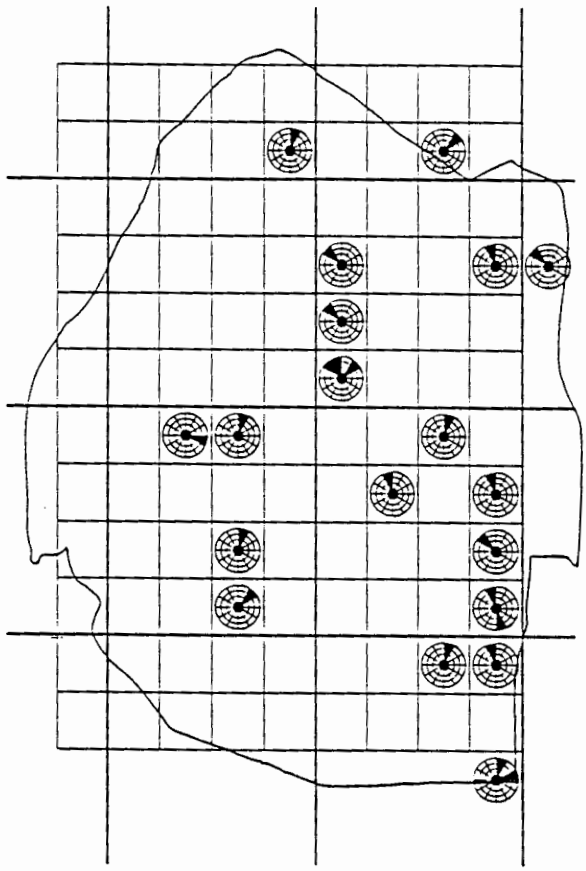
199. Swainson's francolin. (Francolinus swainsonii)

Recording frequency: 260 (/2263) 11%.
Population estimate: 1 000.
Status: Common resident in the highveld and southern middleveld and uncommon elsewhere.
Habitat preference: Most often associated with cultivated lands and also encountered in savanna and woodland.



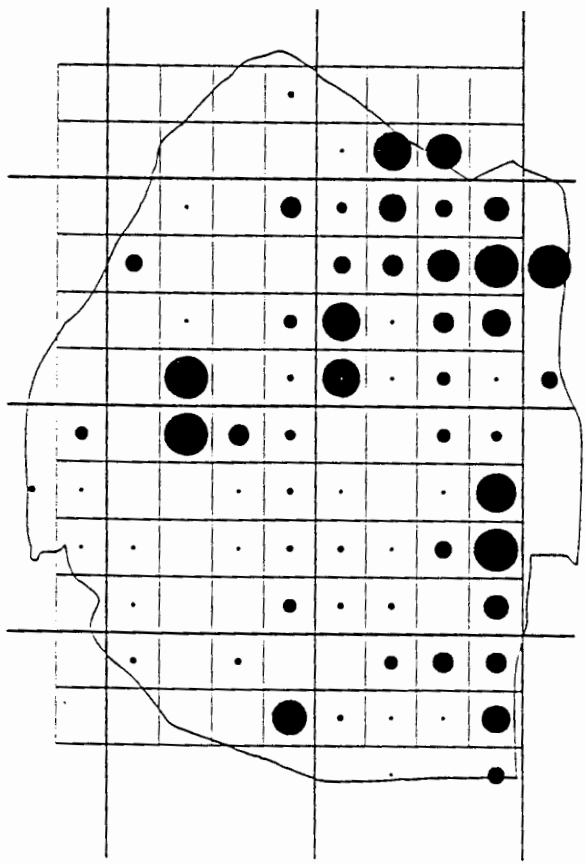
200. Common quail. (Coturnix coturnix)

Recording frequency: 78 (/2263) 3%.
Population estimate: 5 000.
Status: The species appears to be a common breeding summer migrant, with some birds overwintering. Numbers fluctuate considerably from year to year. The species was particularly numerous during the period January to March 1991, when heavy rains followed a dry first half of the summer.
Habitat preference: Grassland, savanna and cultivated lands.



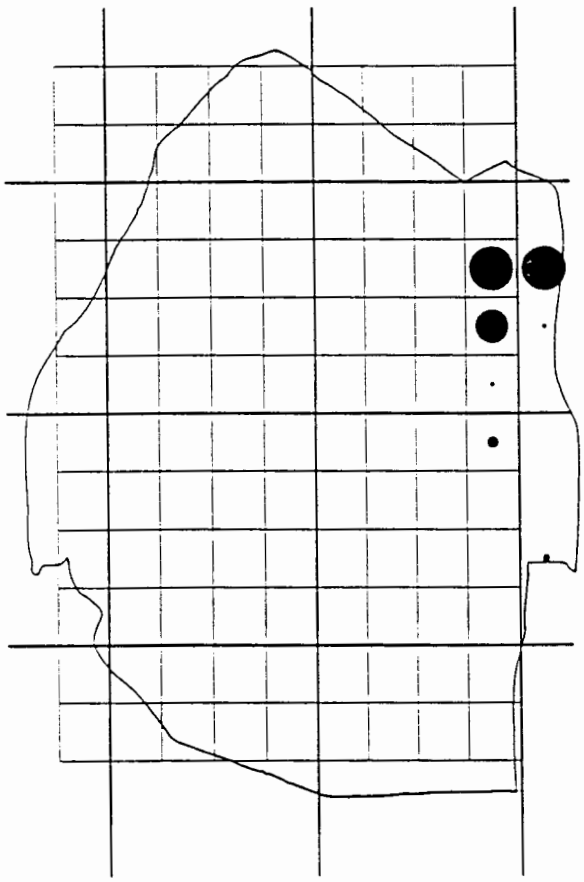
201. Harlequin quail. (Coturnix delegorguei)

Recording frequency: 23 (/2263) 1%.
Population estimate: 1 600.
Status: An uncommon breeding migrant in the lowveld and middleveld with birds overwintering on rare occasions. Numbers vary greatly from year to year and were particulary high during the summer of 1988/89 when particularly heavy rains had fallen early on in the summer. During that summer, the Harlequin quail was encountered more frequently than the common quail, whereas in other summers the latter was far more common than the former.
Habitat preference: Grassland and savanna.



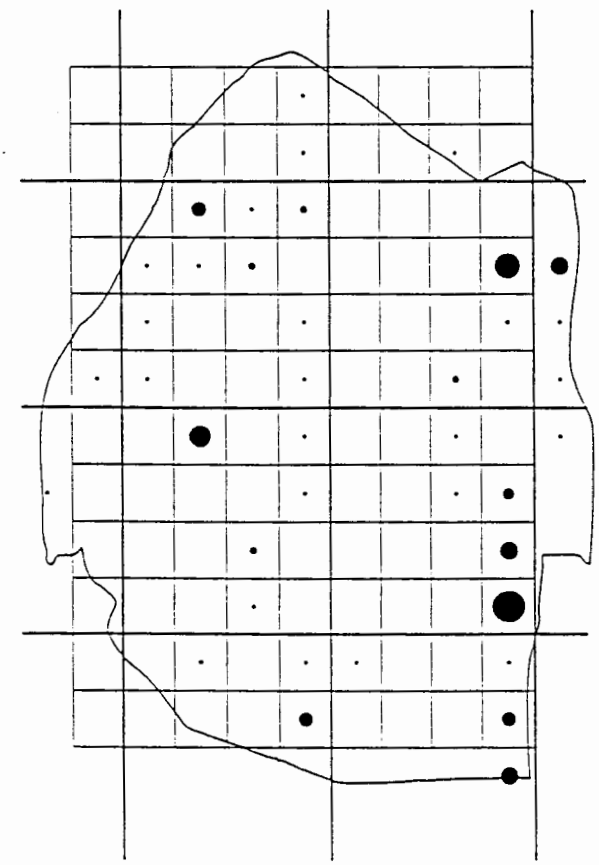
203. Helmeted guineafowl. (Numida meleagris)

Recording frequency: 567 (/2263) 25%.
Population estimate: 6 000.
Status: A breeding resident, rare in the highveld and common elsewhere.
Habitat preference: Woodland, savanna and cultivated lands.



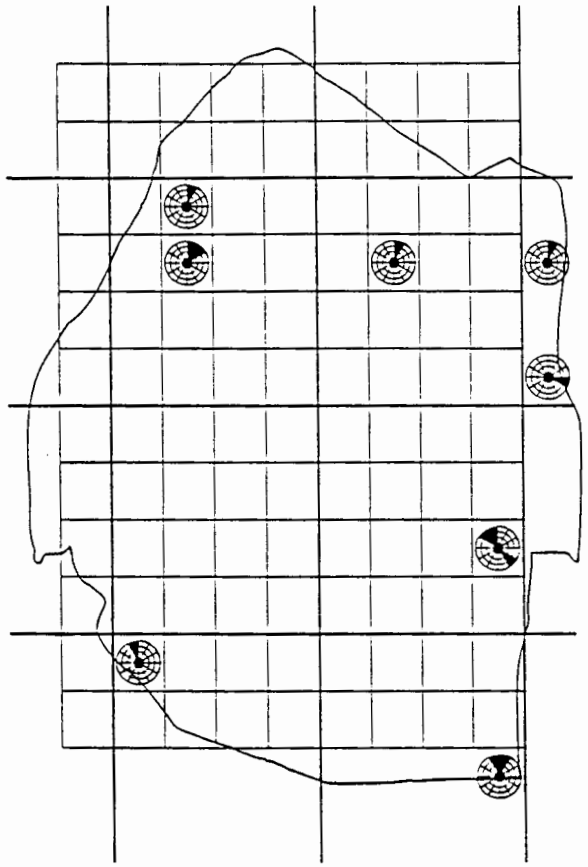
204. Crested guineafowl. (Guttera pucherani)

Recording frequency: 91 (/2263) 4%.
Population estimate: 400.
Status:Uncommon breeding resident in the Lubombos and adjacent parts of the lowveld.
Habitat preference: Woodland and forest.



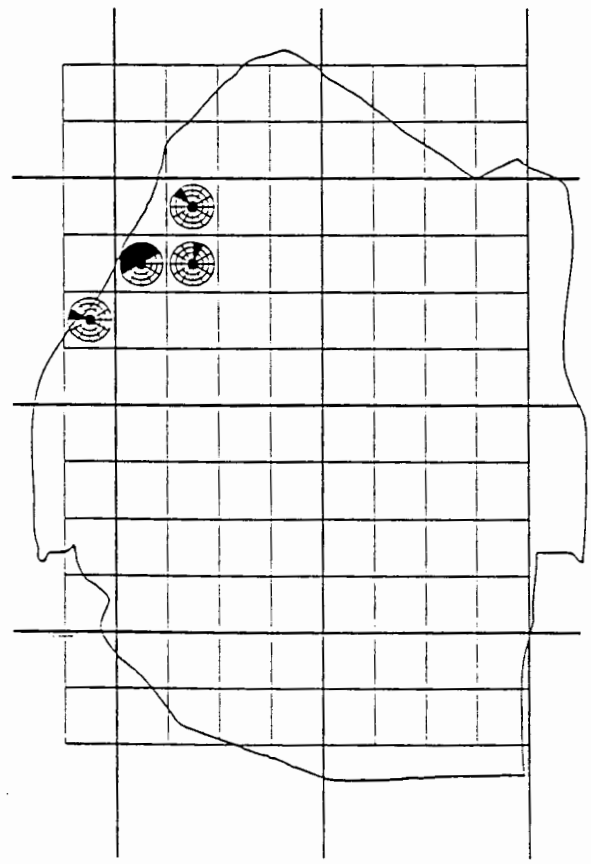
205. Kurrichane buttonquail. (Turnix sylvatica)

Recording frequency: 94 (/2263) 4%.
Population estimate: 1 000.
Status: Uncommon breeding resident occurring in all regions except for the western lowveld.
Habitat preference: Grassland and savanna.



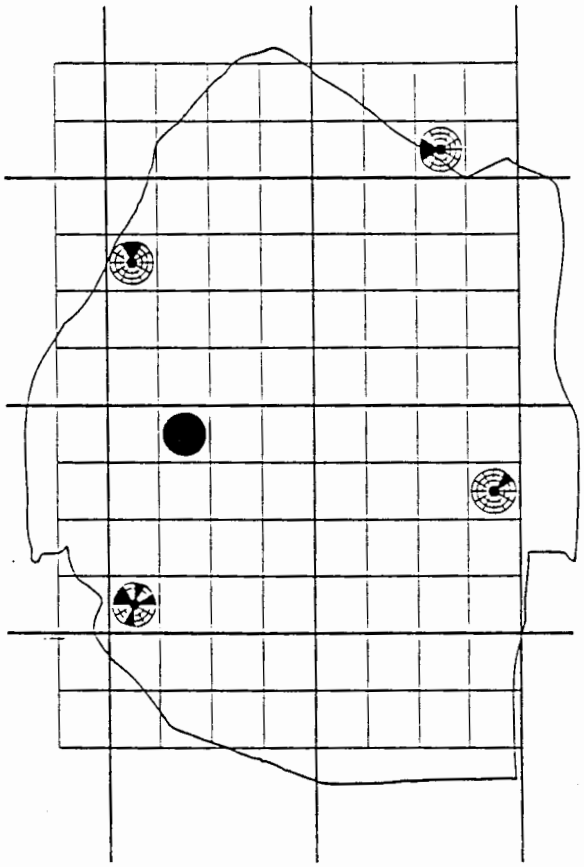
206. Blackrumped buttonquail. (Turnix hottentotta)

Recording frequency: 12 (/2263) 1%.
Population estimate: 70.
Status: Rare, probably a breeding resident.
Habitat preference: Grassland and savanna, usually encountered in long grass.



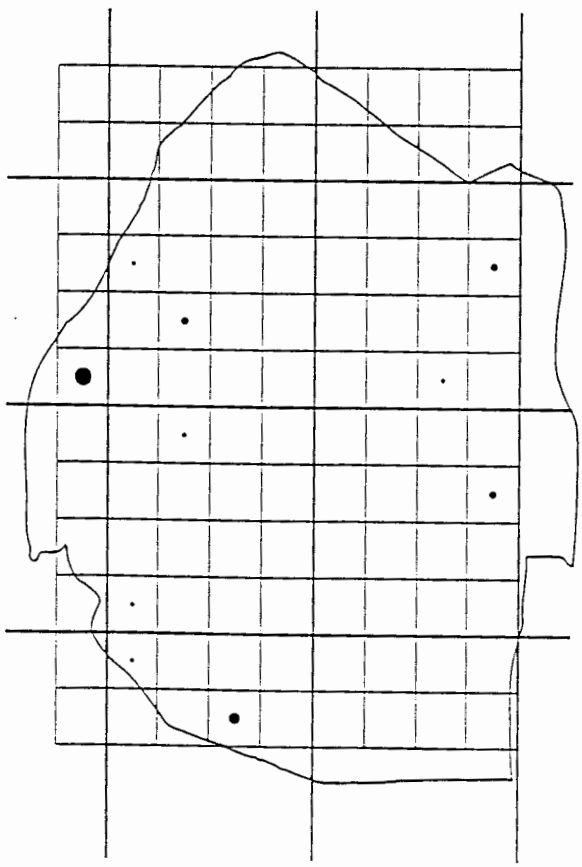
208. Blue crane. (Anthropoides paradisea)

Recording frequency: 9 (/2263) 0,45%.
Population estimate: 12.
Status: Rare breeding summer migrant in the highveld, at present restricted to the Malolotja Nature Reserve (C4, D3, D4).
Habitat preference: Highveld grassland and vleis.



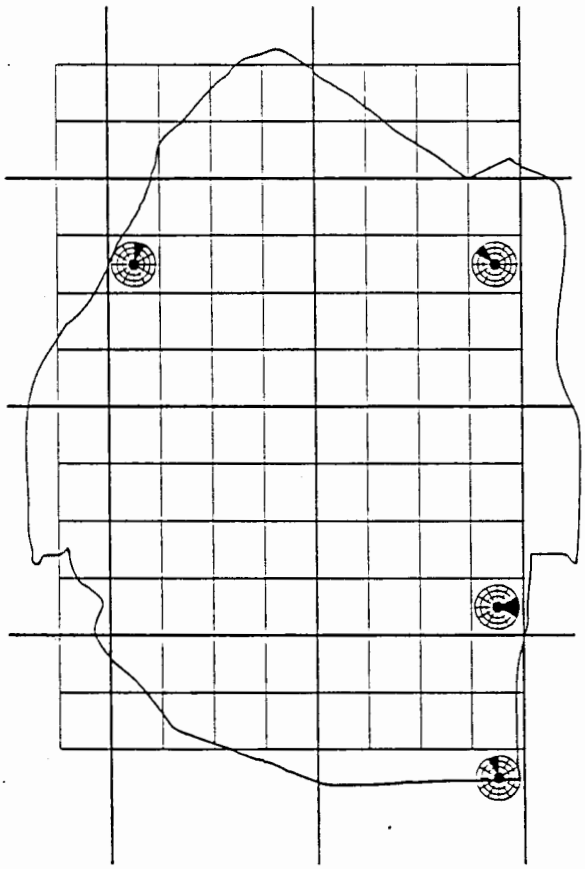
209. Crowned crane. (Balearica regulorum)

Recording frequency: 28 (/2263) 1%.
Population estimate: 2.
Status: Rare. Considered to be a breeding resident only at Gege Vlei (J3) in the south, and a vagrant elsewhere. A single bird was continuously present at Malkerns (G4) for several years. This bird may have been an escapee from Mlilwane Nature Reserve (F4) where the species had been unsuccessfully introduced. A pair used to visit Hawane Vlei (D3) regularly during December and January, but did not return there after the construction of the Hawane Dam in 1987.
Habitat preference: Vleis.



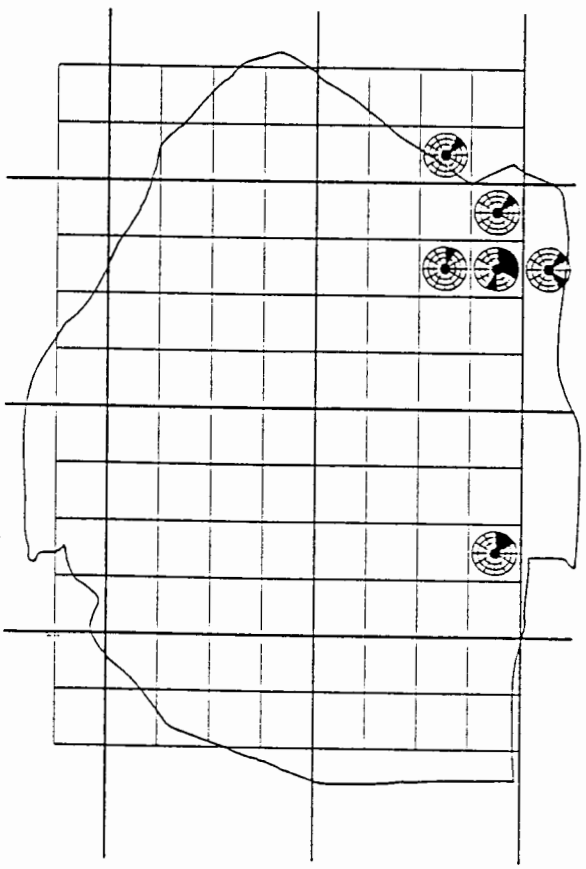
210. African rail. (Rallus caerulescens)

Recording frequency: 18(/2263) 1%.
Population estimate: 100.
Status: Uncommon breeding resident.
Habitat preference: Vleis and dams with reedbeds.



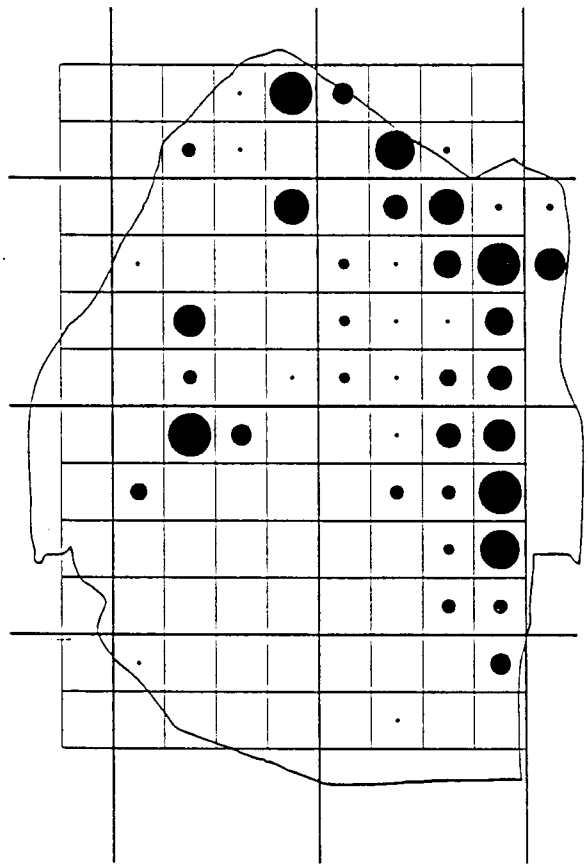
211. Corncrake. (Crex crex)

Recording frequency: 5 (/2263).
Status: Rare summer migrant.
Habitat preference: Rank grass.



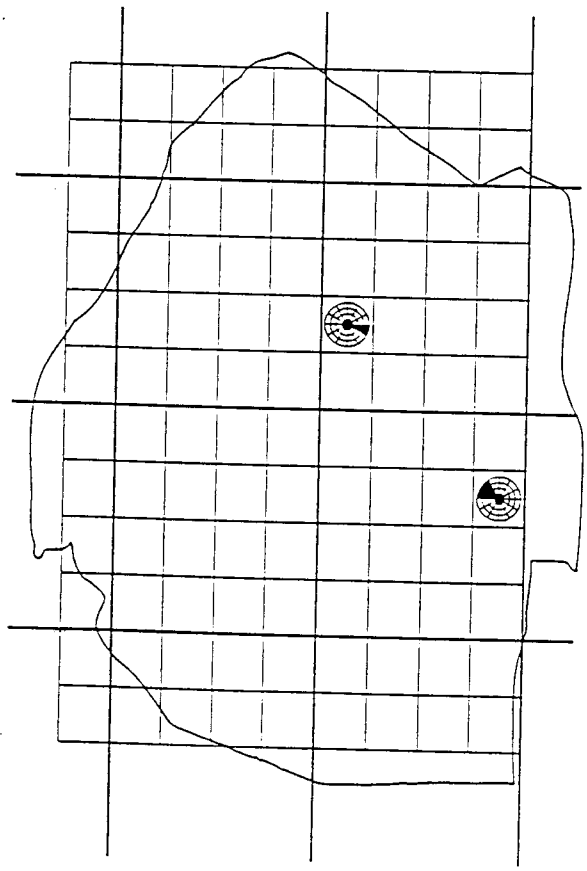
212. African crake. (Crex egregia)

Recording frequency: 12 (/2263) 0,5%.
Population estimate: 100.
Status: Uncommon breeding resident in the eastern lowveld.
Habitat preference: Rank grass.



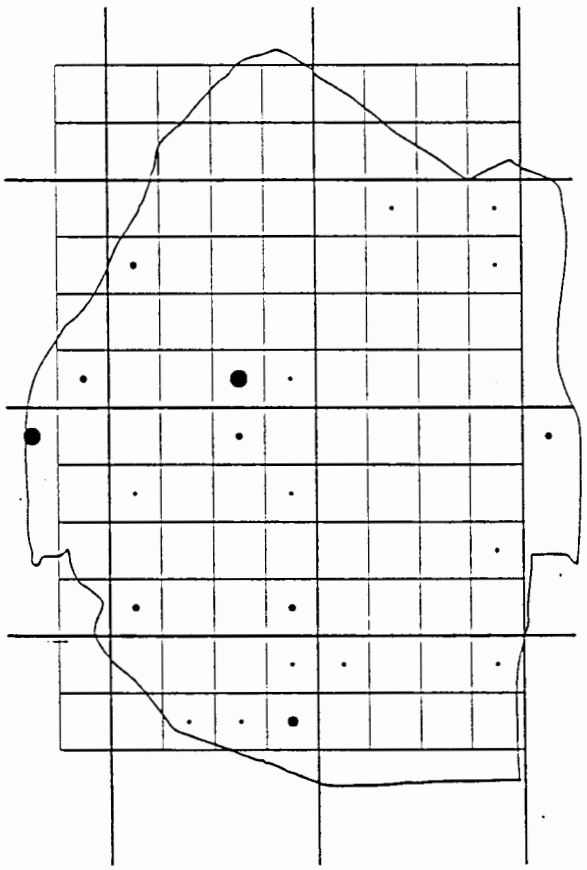
213. Black crake. (Amaurornis flavirostris)

Recording frequency: 345 (/2263) 15%.
Population estimate: 500.
Status: Common breeding resident.
Habitat preference: Open waters with reeds.



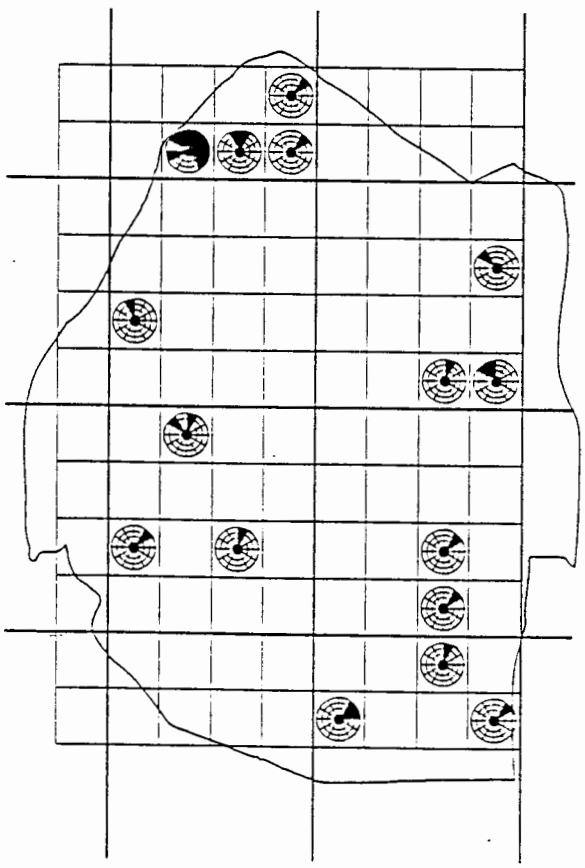
215. Baillon's crake. (Porzana pusilla)

Recording frequency: 3 (/2263) 0,1%.
Status: Rare. It is not known whether the species is a visitor to Swaziland or a breeding resident.
Habitat preference: Small reed lined dams.



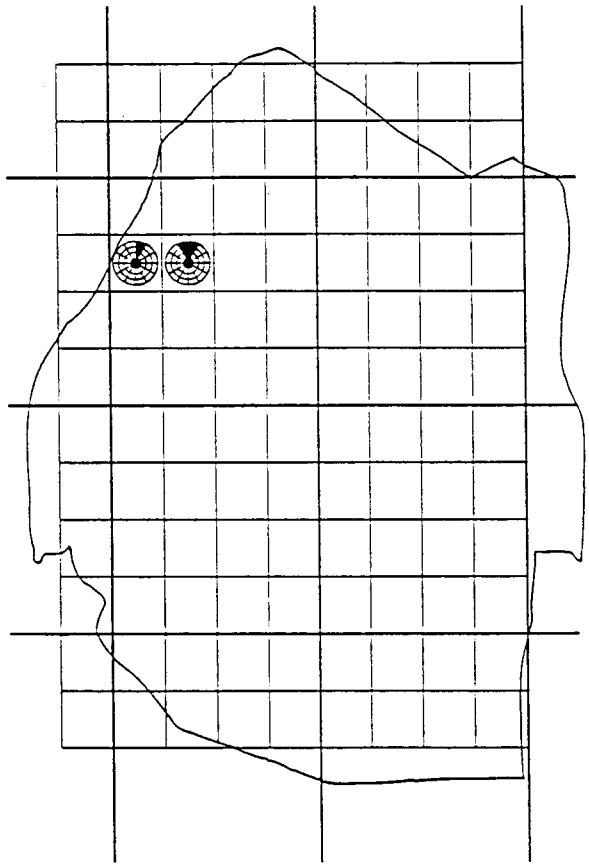
217. Redchested flufftail. (Sarothrura rufa)

Recording frequency: 37 (/2263) 2%.
Population estimate: 200.
Status: Uncommon breeding resident.
Habitat preference: Large reedbeds and occasionally sugar cane fields.



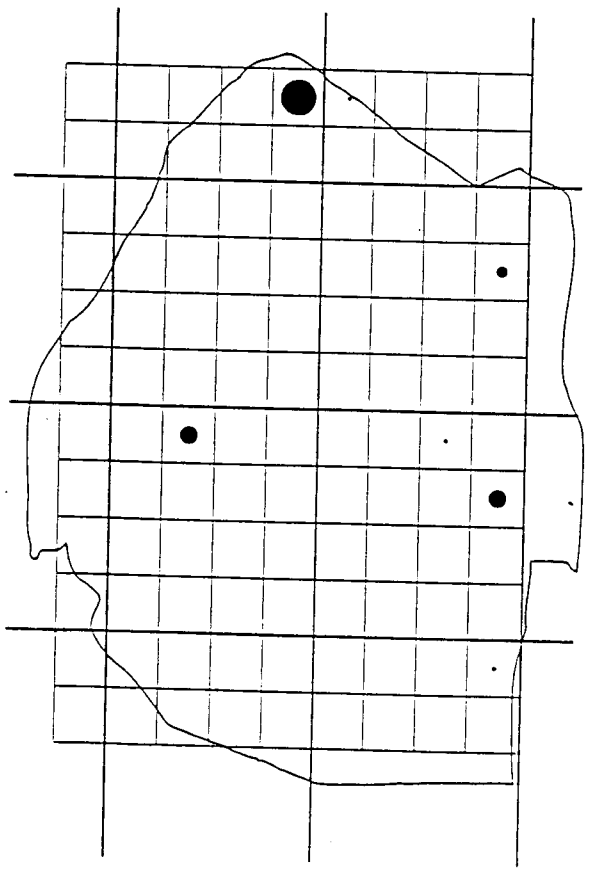
218. Buffspotted flufftail. (Sarothrura elegans)

Recording frequency: 28 (/2263) 1%.
Population estimate: 100.
Status: Uncommon breeding resident.
Habitat preference: Woodland.



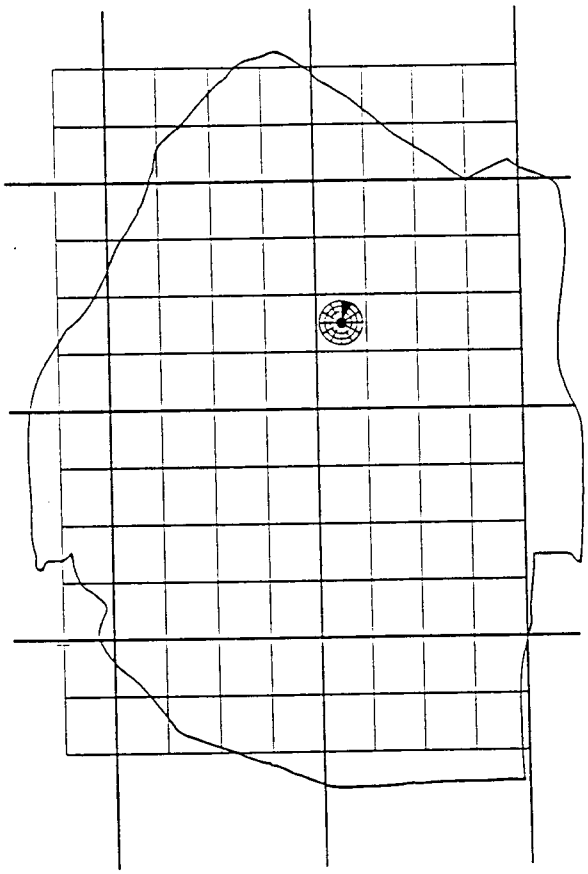
221. Striped flufftail. (Sarothrura affinis)

Recording frequency: 4 (/2263) 0,25%.
Population estimate: 10.
Status: Rare breeding resident, apparently confined to the Malolotja Nature Reserve.
Habitat preference: Vleis in montane grassland.



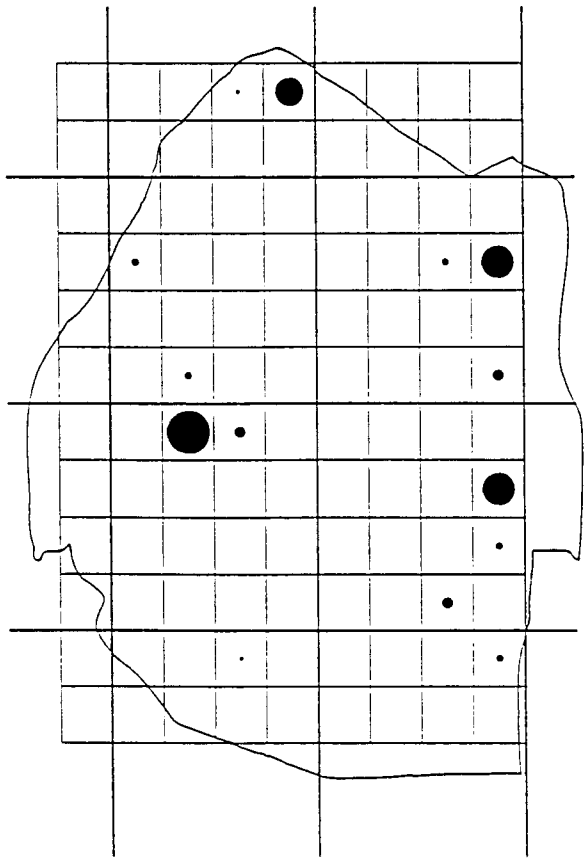
223. Purple gallinule. (Porphyrio porphyrio)

Recording frequency: 31 (/2263) 1%.
Population estimate: 20.
Status: Uncommon breeding resident.
Habitat preference: Dams with reedbeds.



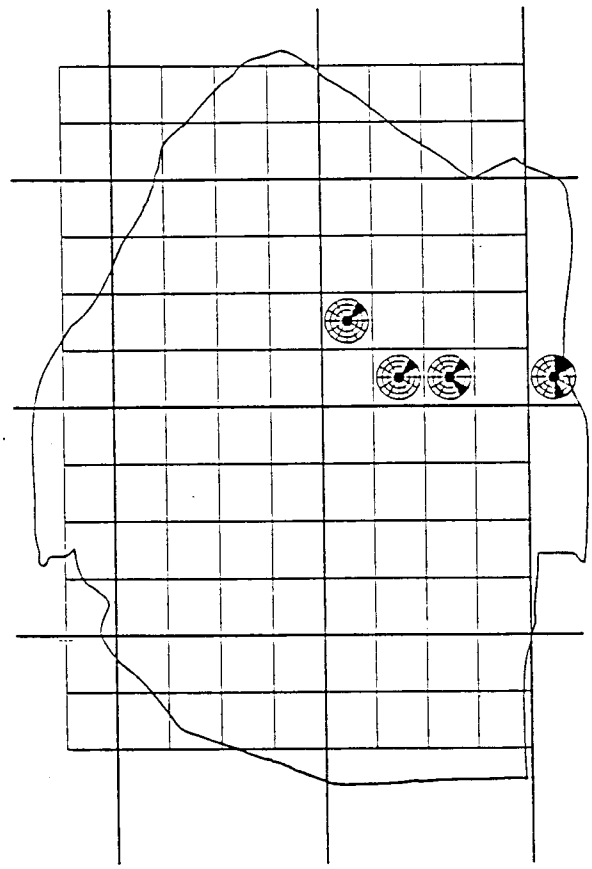
224. Lesser gallinule. (Porphyrio alleni)

Recording frequency: 1 (/2263) 0,05%.
Seen once at a dam near Mafutseni (E7) in January 1991 (VP) and previously at another dam in the same region (F7) in 1970 (J. Culverwell)



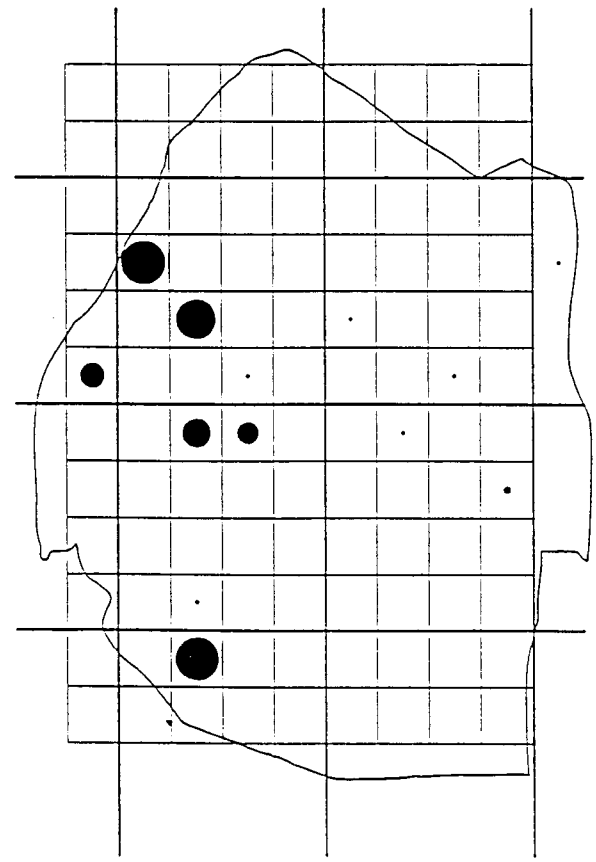
226. Moorhen. (Gallinula chloropus)

Recording frequency: 104 (/2263) 5%.
Population estimate: 30.
Status: Uncommon breeding resident.
Habitat preference: Dams with reedbeds.



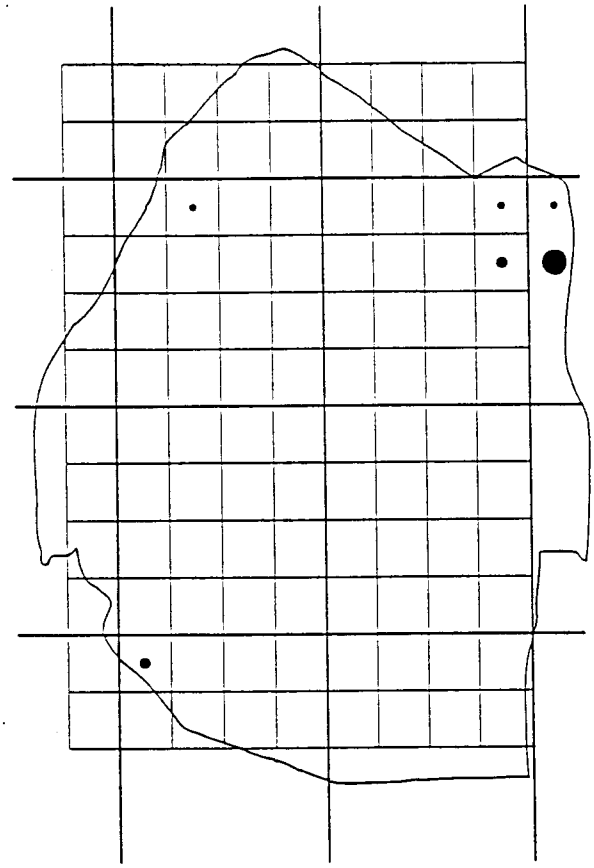
227. Lesser moorhen. (Gallinula angulata)

Recording frequency: 7 (/2263) 0,3%.
Population estimate: 20.
Status: Uncommon breeding summer migrant in the lowveld and Lubombos.
Habitat preference: Temporary pans and pools with flooded grasses.



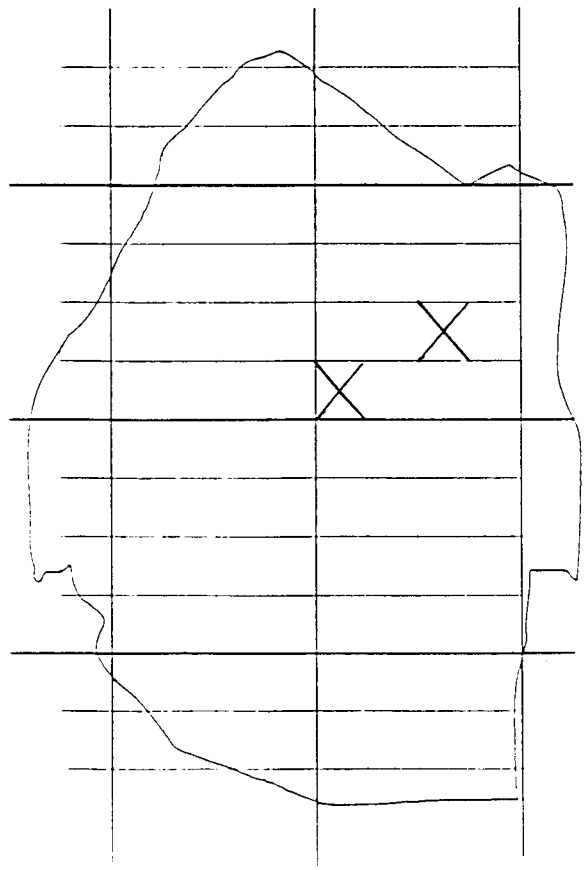
228. Redknobbed coot. (Fulica cristata)

Recording frequency: 113 (/2263) 5%.
Population estimate: 400.
Status: Uncommon breeding resident in the highveld and middleveld and vagrant elsewhere.
Habitat preference: Dams.



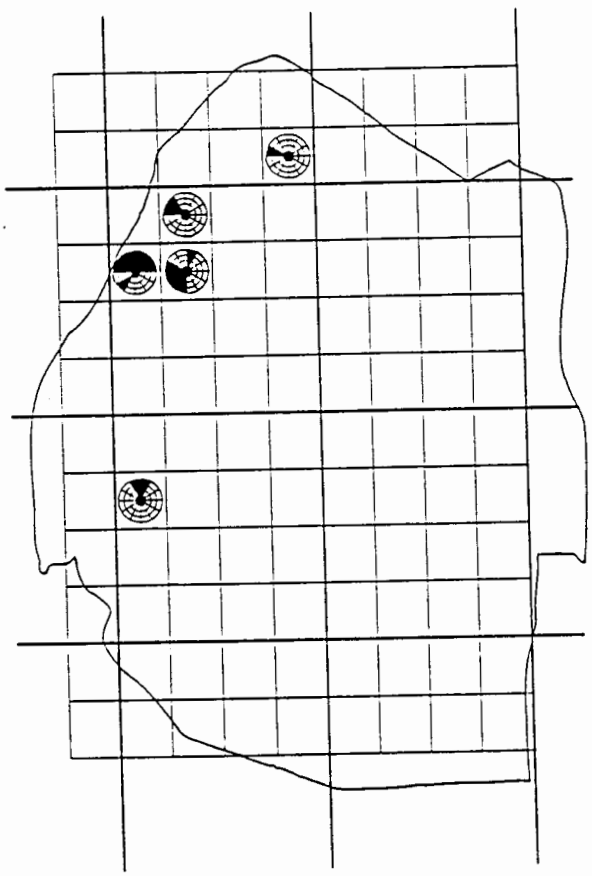
229. African finfoot. (Podica senegalensis)

Recording frequency: 22 (/2263) 1%.
Population estimate: 40.
Status: Uncommon breeding resident.
Habitat preference: Well wooded streams and rivers.



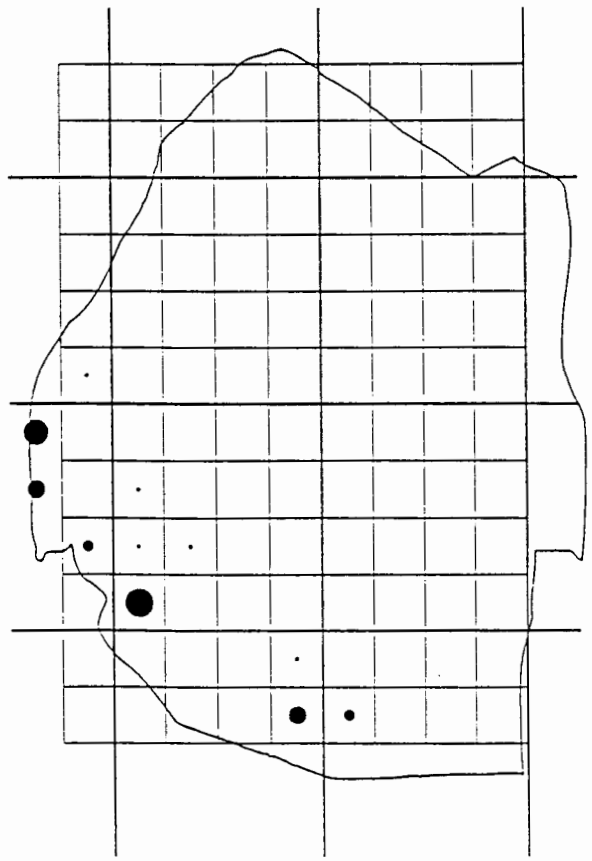
230. Kori bustard. (Ardeotis kori)

Previously known to have occurred in the lowveld at Hlane (E9) and at Mafutseni (F7) and probably more widely (R. Girdwood, R. Harding pers. comm.), but no longer occurs in Swaziland. It is believed to have been hunted to local extinction prior to 1960. Subsequently, bush encroachment has made much of its former range unsuitable for the species.



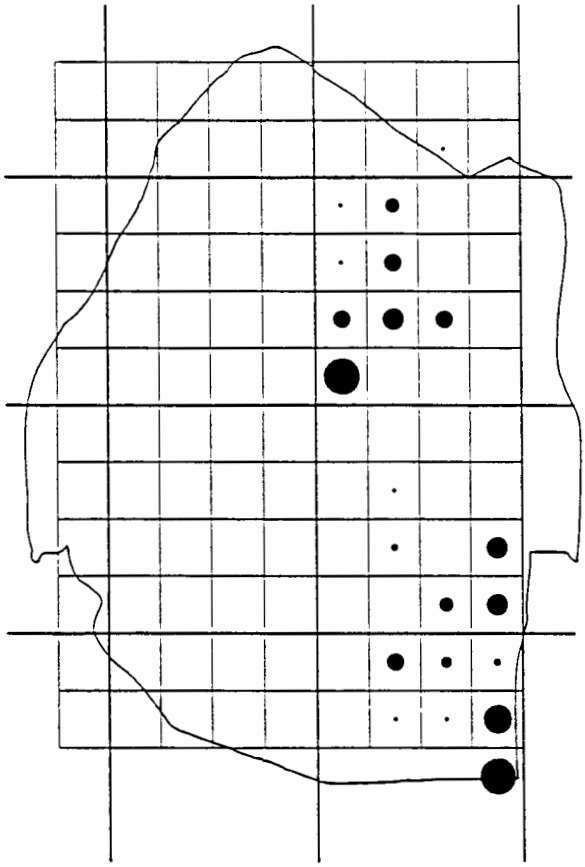
231. Stanley's bustard. (Neotis denhami)

Recording frequency: 19 (/2263) 1%.
Population estimate: 20.
Status: Rare breeding resident in the highveld. Probably restricted to the Malolotja Nature Reserve (C4, D3, D4) as a breeding species (breeding evidence consists of observations of displaying males and the presence of young birds) and a vagrant elsewhere.
Habitat preference: Highveld grassland.



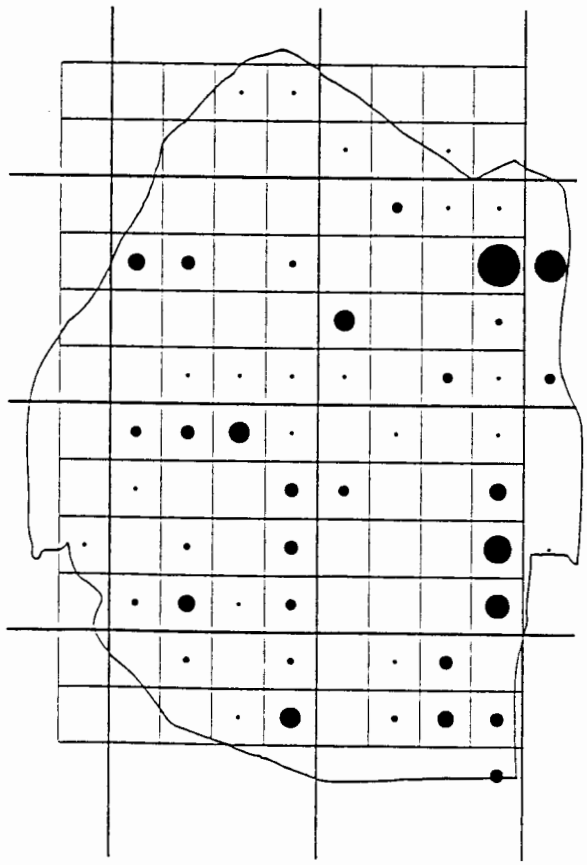
233. Whitebellied korhaan. (Eupodotis cafra)

Recording frequency: 36 (/2263) 2%.
Population estimate: 100.
Status: Uncommon breeding resident in the southern highveld and southern middleveld.
Habitat preference: Grassland.



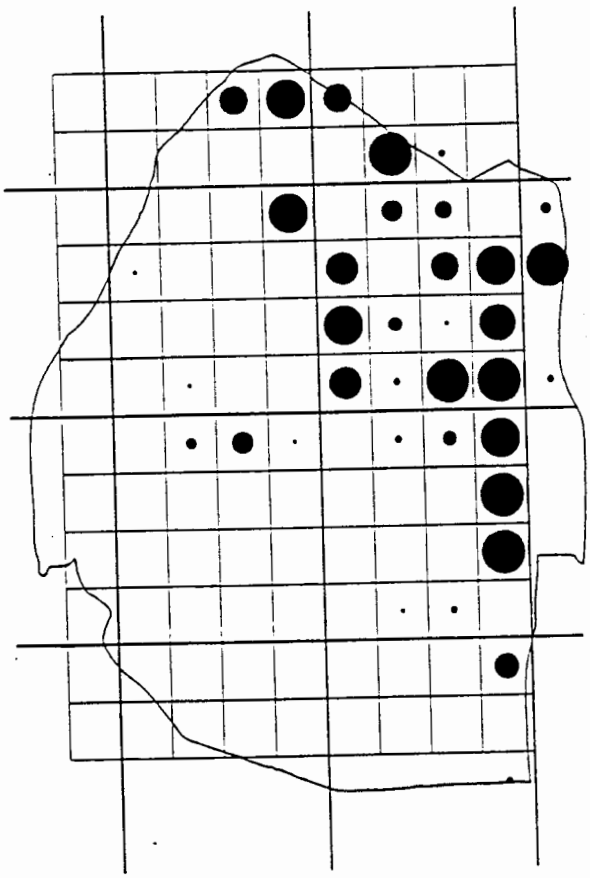
237. Redcrested korhaan. (Eupodotis ruficrista)

Recording frequency: 92 (/2263) 4%.
Population estimate: 200.
Status: Uncommon breeding resident in lightly wooded parts of the lowveld.
Habitat preference: Thorn savanna.



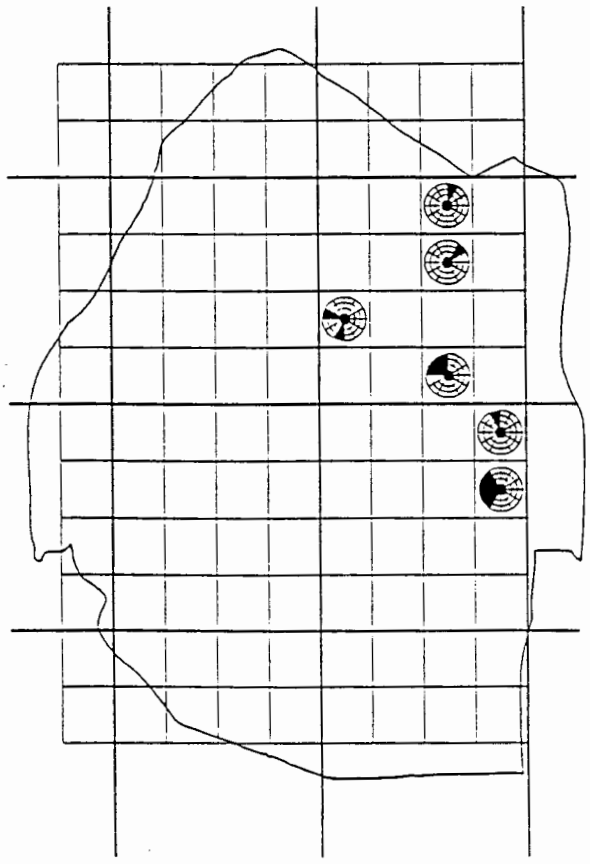
238. Blackbellied korhaan. (Eupodotis melanogaster)

Recording frequency: 183 (/2263) 8%.
Population estimate: 400.
Status: Uncommon breeding resident.
Habitat preference: Grassland, vleis and savanna.



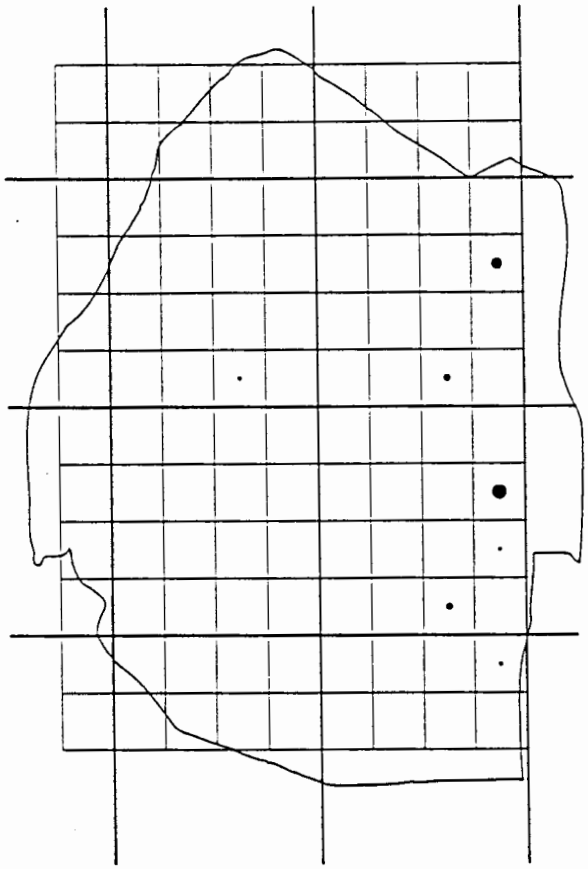
240. African jacana. (Actophilornis africanus)

Recording frequency: 372 (/2263) 16%.
Population estimate: 400.
Status: A breeding resident, common in the lowveld, uncommon in the Lubombos and middleveld and a vagrant in the highveld.
Habitat preference: Dams with floating vegetation, especially waterlilies.



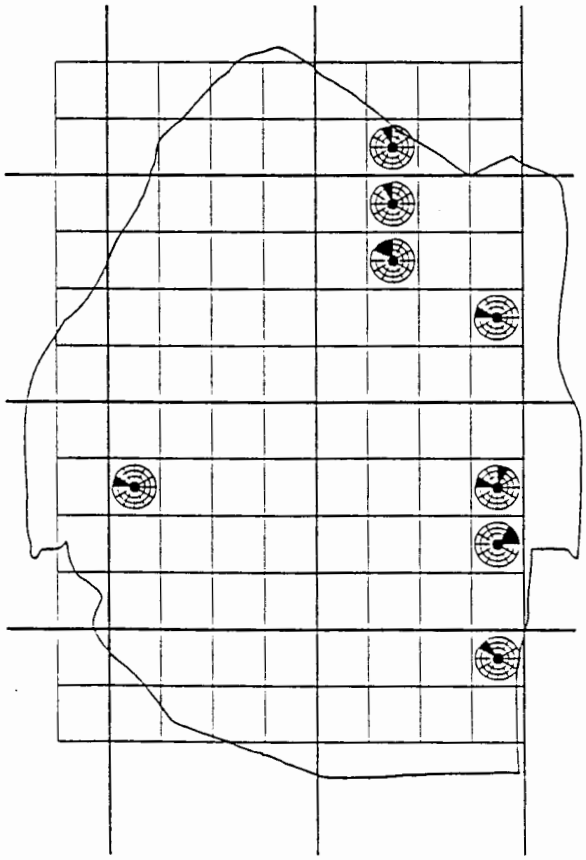
241. Lesser jacana. (Microparra capensis)

Recording frequency: 13 (/2263) 1%.
Status: Uncommon visitor in the lowveld.
Habitat preference: Small, reed-lined dams and mudflats.



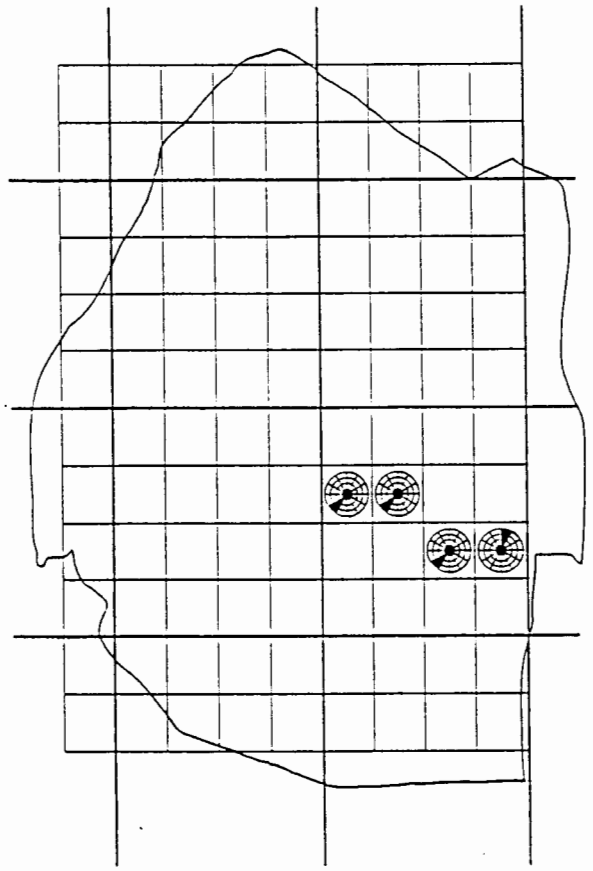
242. Painted snipe. (Rostratula benghalensis)

Recording frequency: 14 (/2263) 1%.
Status: Uncommon visitor in the middleveld and lowveld.
Habitat preference: Dams with emergent vegetation and mudflats.



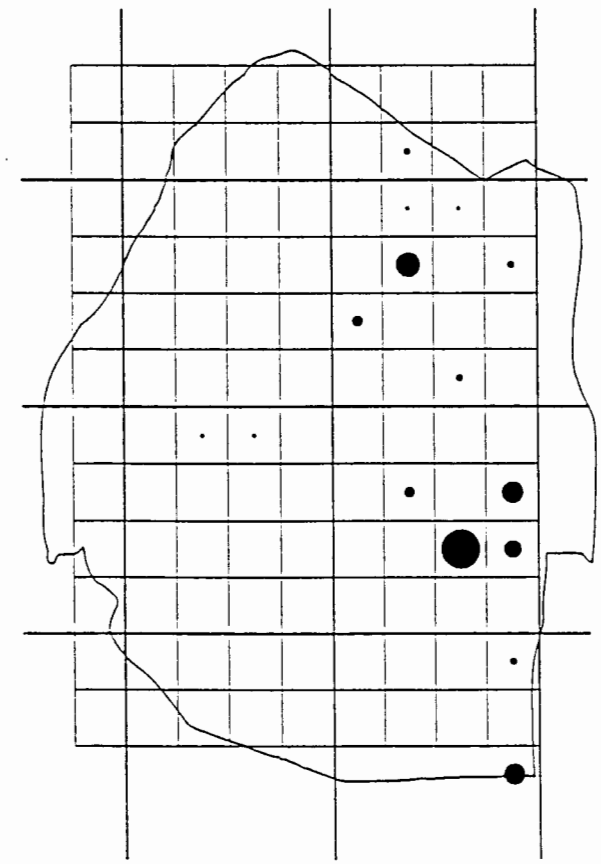
245. Ringed plover. (Charadrius hiaticula)

Recording frequency: 11 (/2263) 0,45%.
Status: Rare summer migrant in the lowveld and middleveld.
Habitat preference: Dams with mudflats.



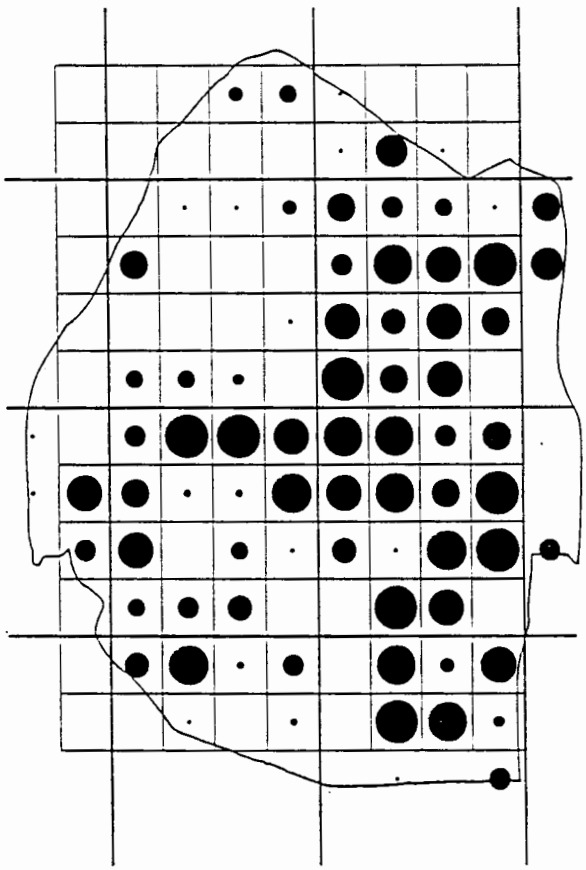
246. Whitefronted plover. (Charadrius marginatus)

Recording frequency: 4 (/2263) 0,2%.
Status: Rare vagrant in the lowveld, with most sightings in August, when water levels are lowest.
Habitat preference: Sand banks along the Usutu River.



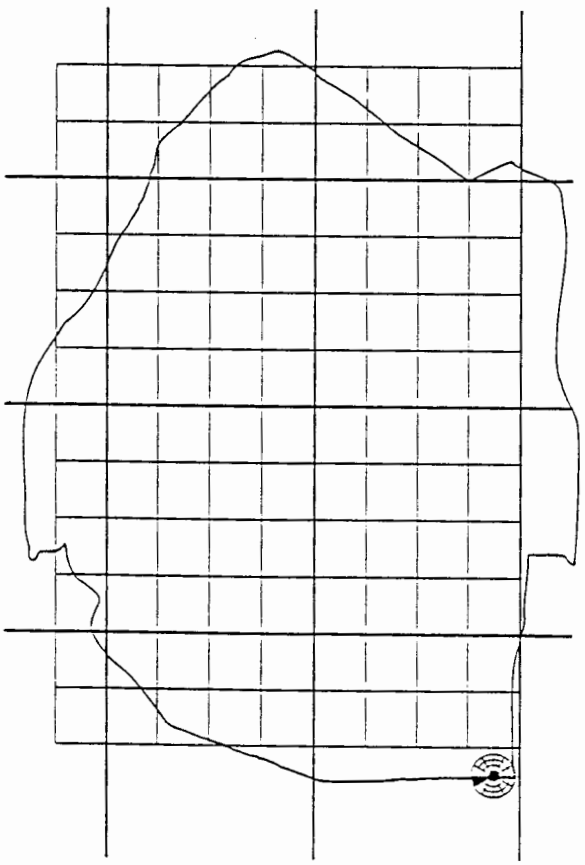
248. Kittlitz's plover. (Charadrius pecuarius)

Recording frequency: 62 (/2263) 3%.
Population estimate: 200.
Status: Uncommon breeding resident in the middleveld and lowveld.
Habitat preference: Sandy riverbeds and dams with mudflats.



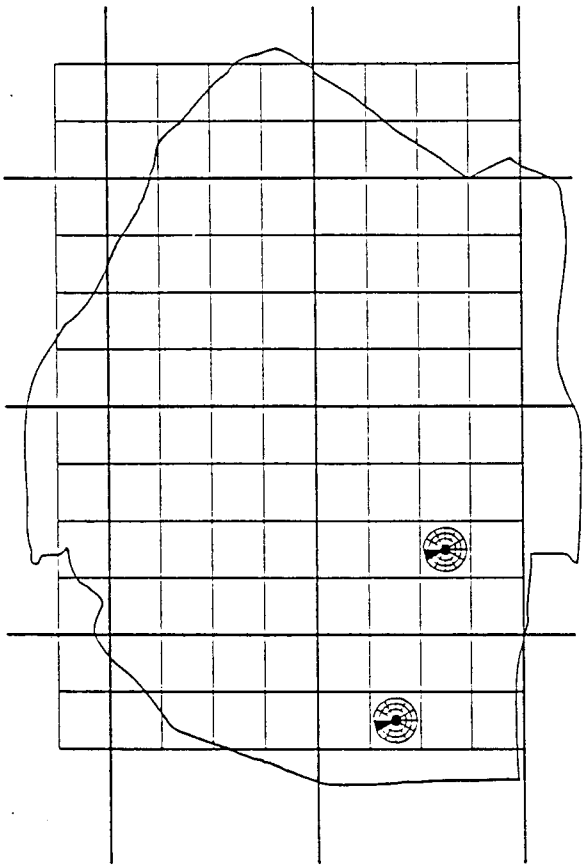
249. Threebanded plover. (Charadrius tricollaris)

Recording frequency: 695 (/2263) 31%.
Population estimate: 1 000.
Status: Common breeding resident.
Habitat preference: Dams and rivers.



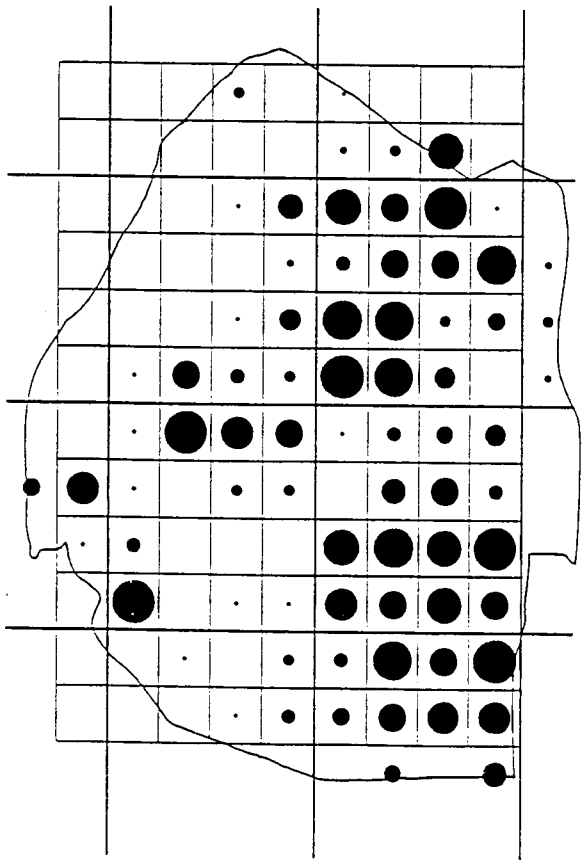
252. Caspian plover. (Charadrius asiaticus)

One bird was seen at Jozini dam (M10) in September 1991 (VP).



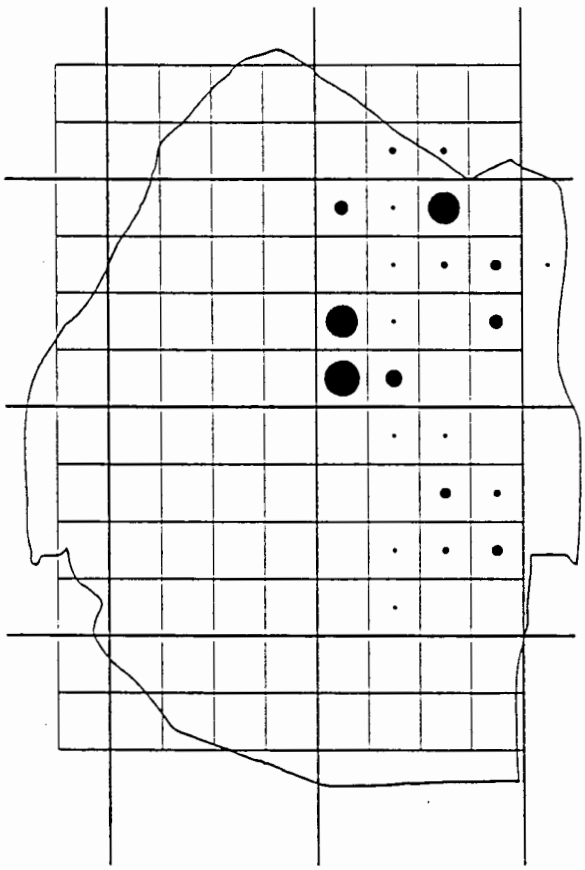
254. Grey plover. (Pluvialis squatarola)

Single birds were seen on a sandbank on the Usutu river (I9) in September 1990 (VP) and on the Ingwavuma River (K7) in September 1991 (VP).



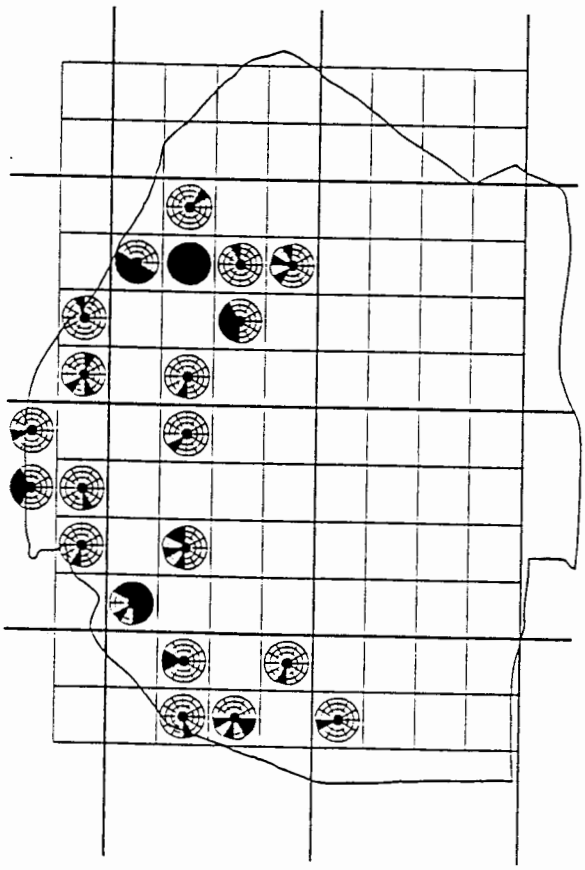
255. Crowned plover. (Vanellus coronatus)

Recording frequency: 578 (/2263) 26%.
Population estimate: 2 000.
Status: Common breeding resident in most areas but an uncommon visitor in the Lubombos and vagrant in the northern highveld.
Habitat preference: Grassland and savanna and lawns in urban areas.



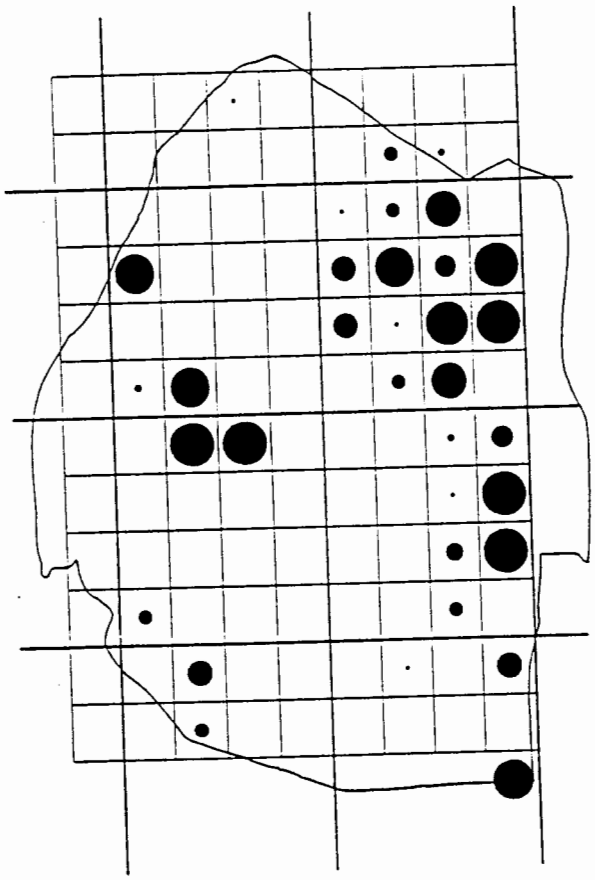
256. Lesser blackwinged plover. (Vanellus lugubris)

Recording frequency: 93 (/2263) 4%.
Population estimate: 50.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Savanna.



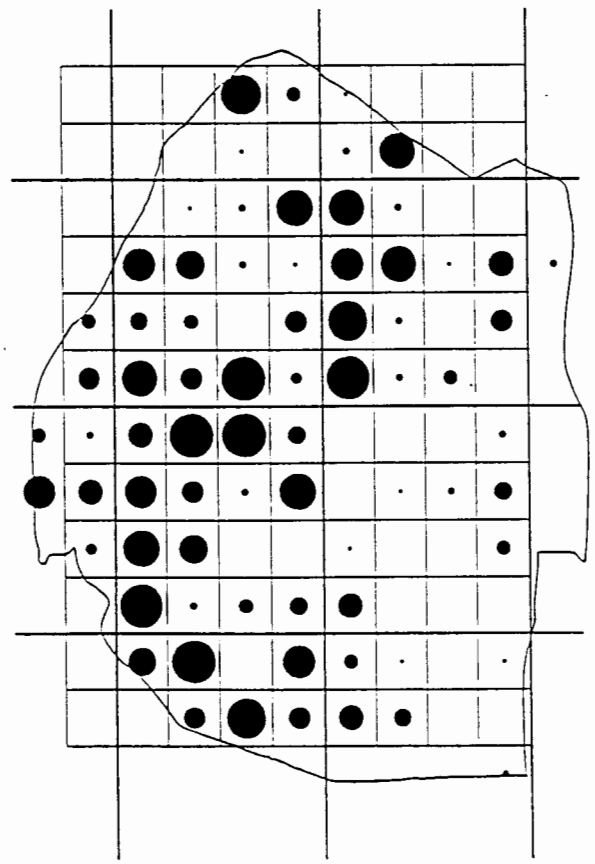
257. Blackwinged plover. (Vanellus melanopterus)

Recording frequency: 80 (/2263) 4%.
Population estimate: 200.
Status: Uncommon breeding resident in the highveld.
Habitat preference: Highveld grassland. During the late winter and early summer (when breeding occurs), the species is found in small flocks (5-10 birds) on burnt ground in pristine grassland areas. In the late summer and early winter, when the grass is longer, the birds move to overgrazed areas where short grass is still available. Here they gather in flocks of up to 60 birds.



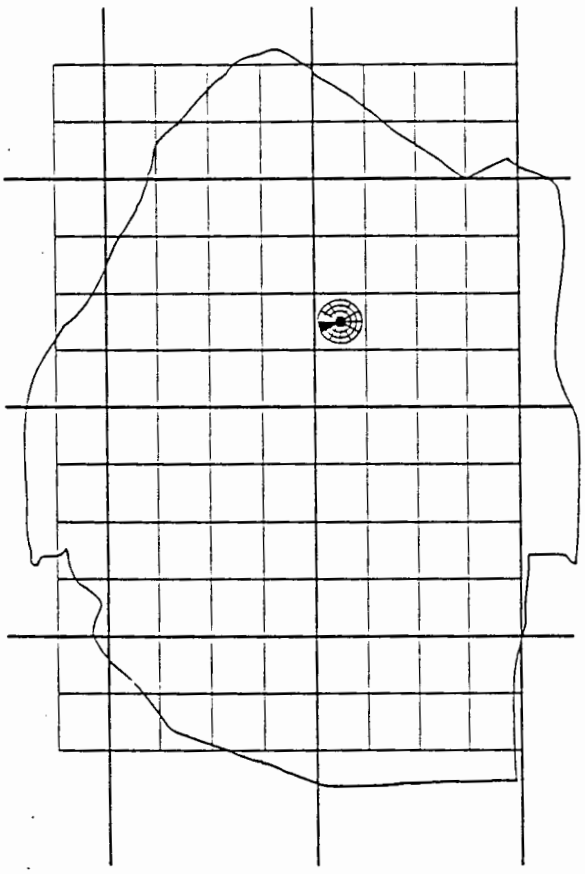
258. Blacksmith plover. (Vanellus armatus)

Recording frequency: 422 (/2263) 19%.
Population estimate: 400.
Status:Common breeding resident.
Habitat preference: Dams with mudflats and sandy riverbeds.



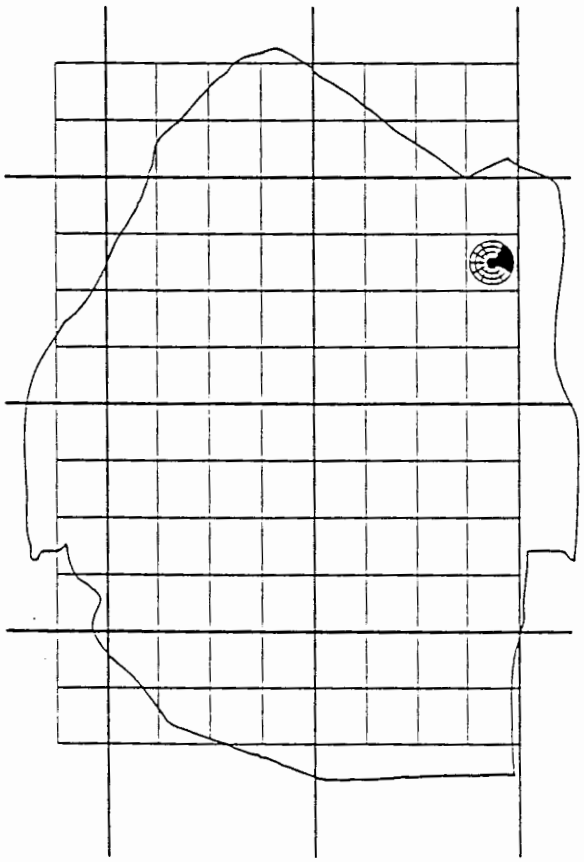
260. Wattled plover. (Vanellus senegallus)

Recording frequency: 598 (/2263) 26%.
Population estimate: 700.
Status:A breeding resident, common in the highveld and middleveld and uncommon in the lowveld.
Habitat preference: Vleis.



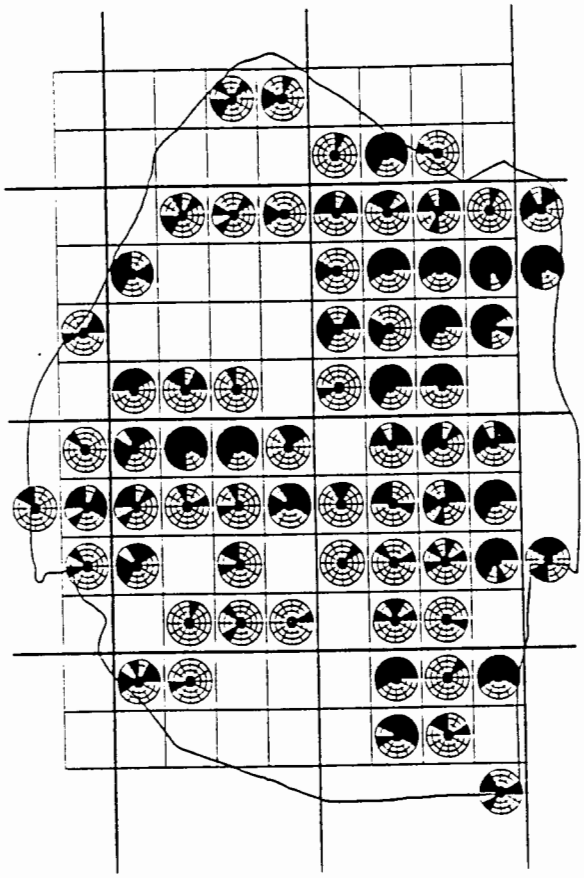
262. Turnstone. (Arenaria interpres)

Two birds were seen at a dam near Mafutseni (E7) in September 1989 (VP).

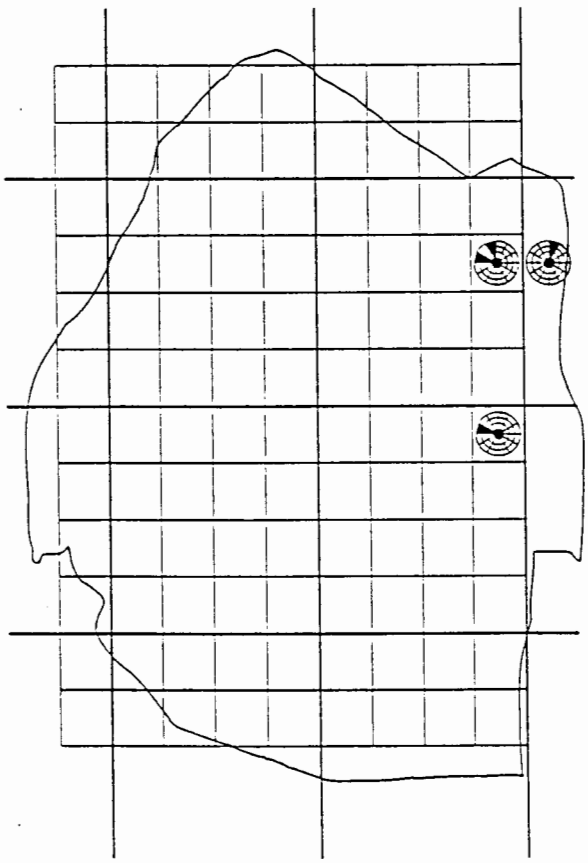


263. Terek sandpiper. (Xenus cinereus)

A single bird was seen several times at the settling pans at Simunye (D10) in February and March 1988 (T. & P. Sandiford and D. & D. Hill).

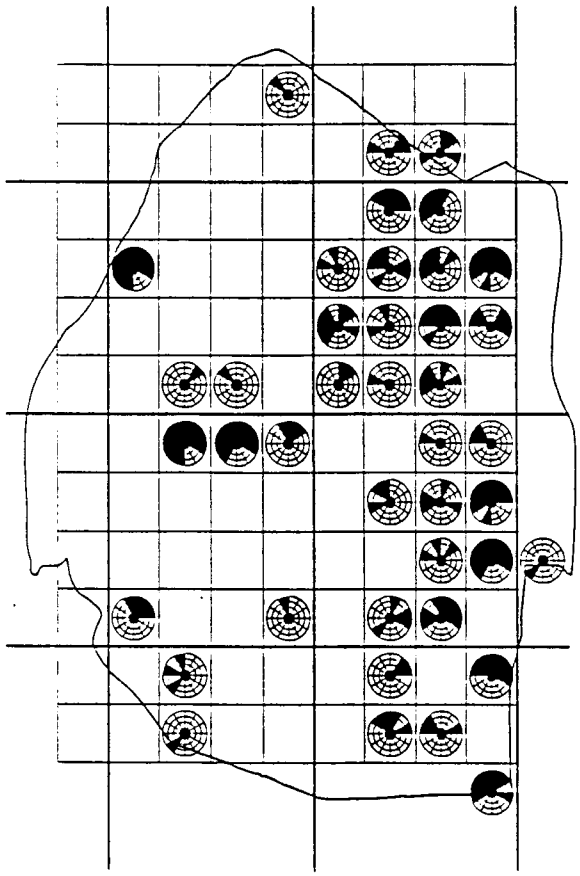


264. Common sandpiper. (Tringa hypoleucus)
Recording frequency: 456 (/2263) 20%.
Status: Very common summer migrant.
Habitat preference: Rivers and dams, seen most often along rocky riverbeds.



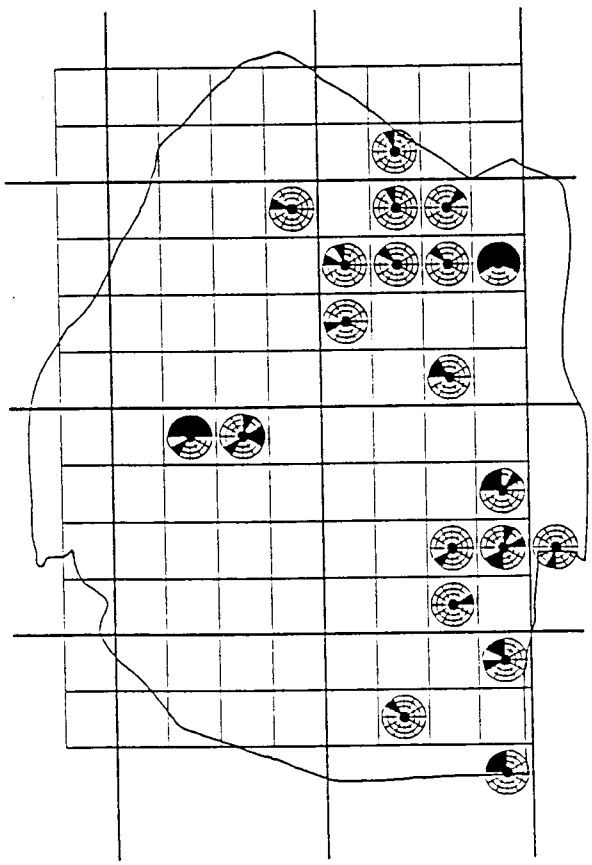
265. Green sandpiper. (Tringa ochropus)

Recording frequency: 4 (/2263) 0,2%.
Status: Recorded at Matshapa (G5) in February 1967 (P. Frost). During the atlas period two sightings of single birds along a wooded stream at Mlawula (D11) (VP) were confirmed by the SAOS Rarities Committee and one at a small dam near Siteki (G10) (VP) is still awaiting confirmation. At least three probable sightings of the species were not submitted to the SAOS Rarities Committee for confirmation, as the observers were not aware of the "rarity" status of the species in Southern Africa. It may be a regular migrant to the Swaziland lowveld.



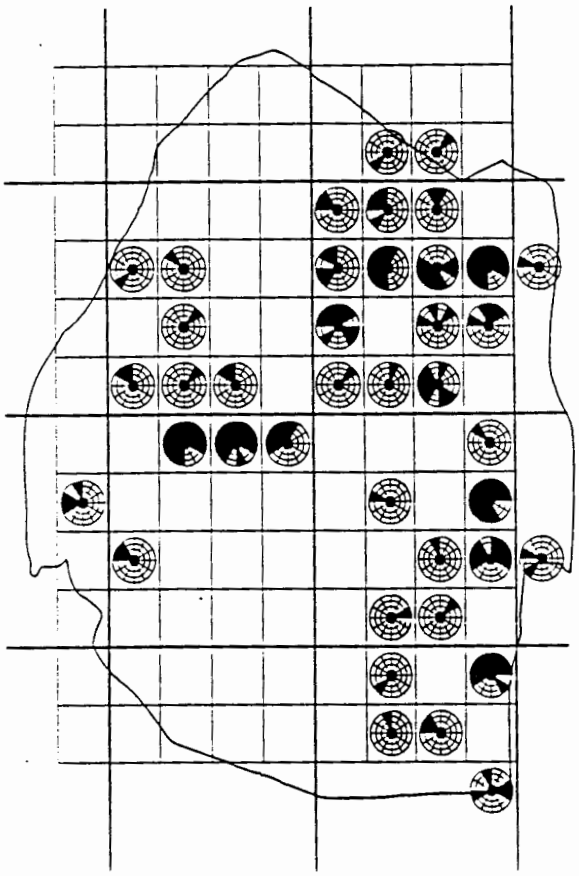
266. Wood sandpiper. (Tringa glareola)

Recording frequency: 264 (/2263) 12%.
Status: Common summer migrant.
Habitat preference: Dams with mudflats and sandy riverbeds.



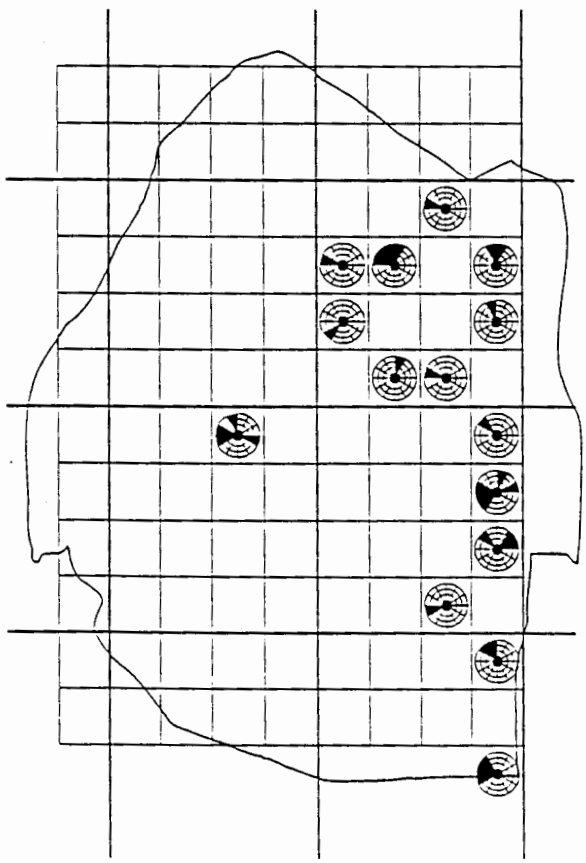
269. Marsh sandpiper. (Tringa stagnatilis)

Recording frequency: 57 (/2263) 3%.
Status: Uncommon summer migrant. Usually solitary but sometimes in flocks of up to 10 birds.
Habitat preference: Dams with mudflats and sandy river beds.

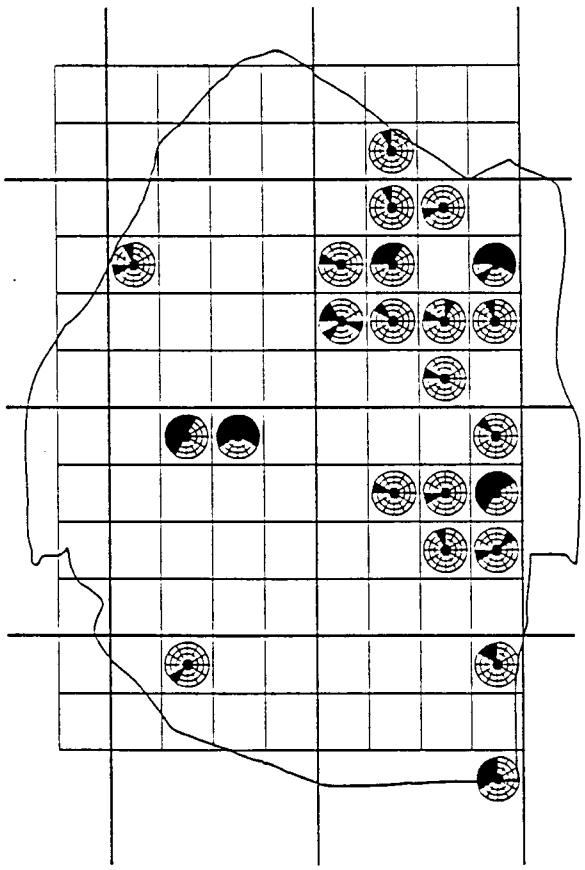


270. Greenshank. (Tringa nebularia)

Recording frequency: 186 (/2263) 8%.
Status: Common summer migrant with a few birds overwintering. Usually solitary or in pairs.
Habitat preference: Dams with mudflats and sandy riverbeds.

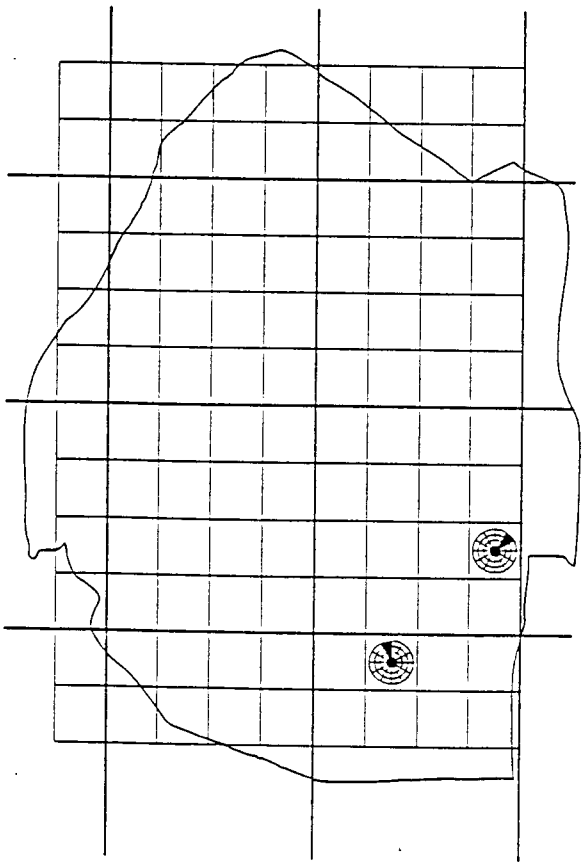


272. Curlew sandpiper. (Calidris ferruginea)
Recording frequency: 32 (/2263) 1%.
Status: Uncommon summer migrant in the middleveld and lowveld.
Habitat preference: Dams with mudflats. Usually encountered in small flocks (5-10 birds) but flocks exceeding 100 birds have been encountered at Mnjoli Dam (D7).



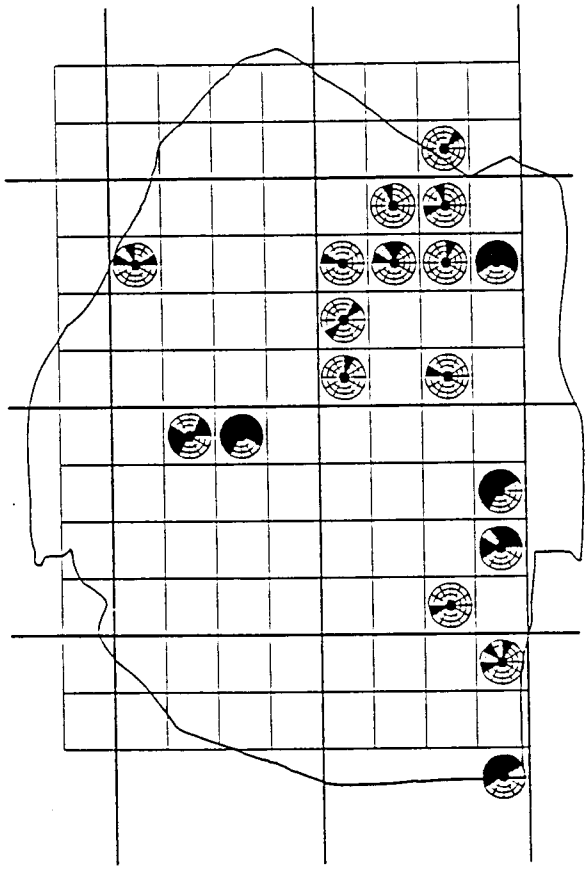
274. Little stint. (Calidris minuta)

Recording frequency: 73 (/2263) 3%.
Status:Uncommon summer migrant. Usually in small flocks (5-10 birds) but occasionally in flocks of up to 100.
Habitat preference: Dams with mudflats.



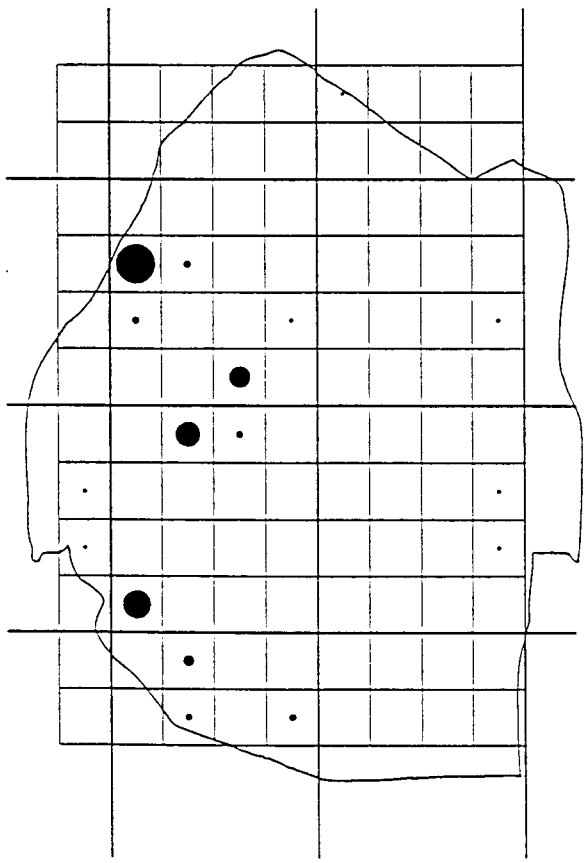
281. Sanderling. (Calidris alba)

Single birds were seen at the Van Eck Dam at Big Bend (I10) in February 1988 (VP) and at a dam near Maloma (K8) in December 1991 (VP).



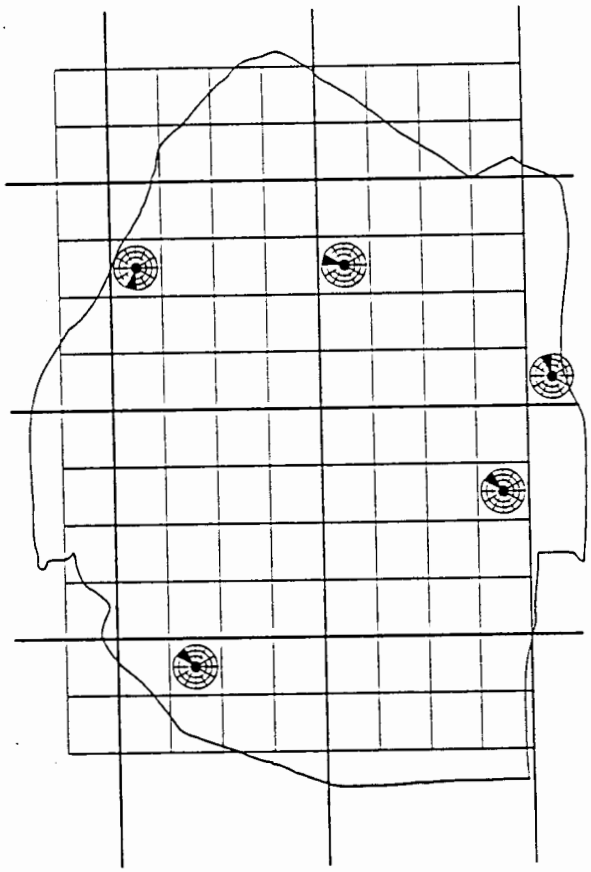
284. Ruff. (Philomachus pugnax)

Recording frequency: 89 (/2263) 4%.
Status: Uncommon summer migrant, usually encountered in small flocks (5-20 birds).
Habitat preference: Dams with mudflats.



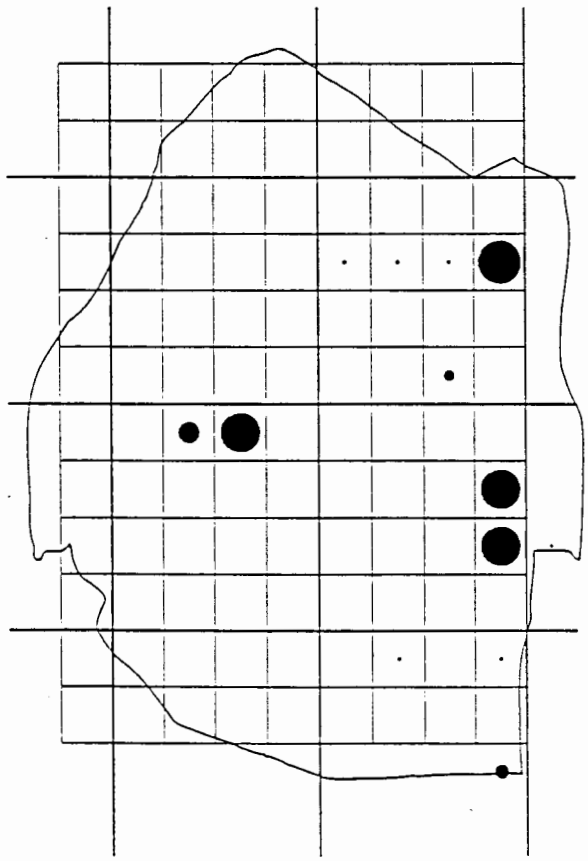
286. Ethiopian snipe. (Gallinago nigripennis)

Recording frequency: 70 (/2263) 3%.
Population estimate: 200.
Status: Uncommon breeding resident in the highveld and middleveld and vagrant in the lowveld.
Habitat preference: vleis.



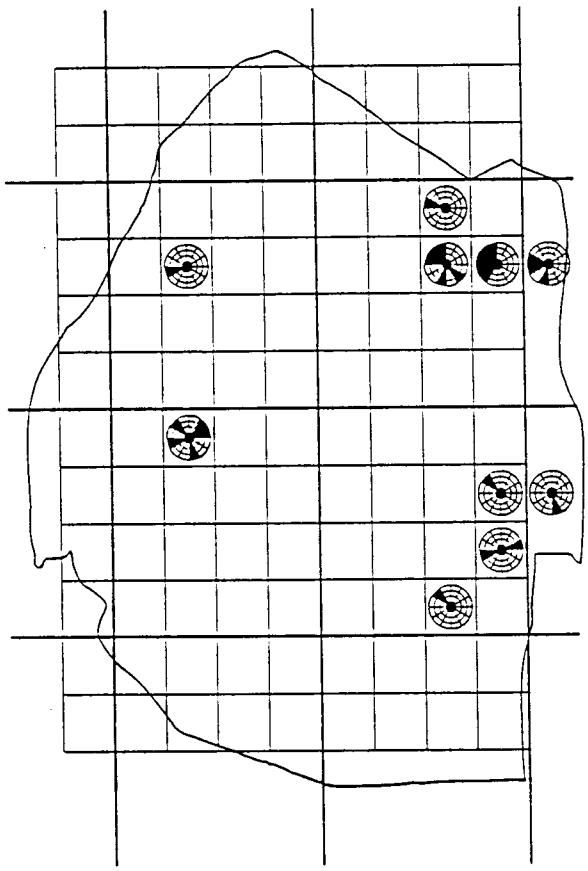
294. Avocet. (Recurvirostra avosetta)

Recorded at Tambankulu (D10) in April 1980 (J. Culverwell) and during the atlas period at Sifunga (H10) in November 1988 (VP), at Sitsatsaweni (F11) in December 1989 (VP), at Hawane (D3) in July 1990 (R. Kirker), at Mnjoli dam (D7) in October 1990 (VP) and at Nhlangano (K4) in November 1990 (VP) in groups of from 1 to 10 birds.

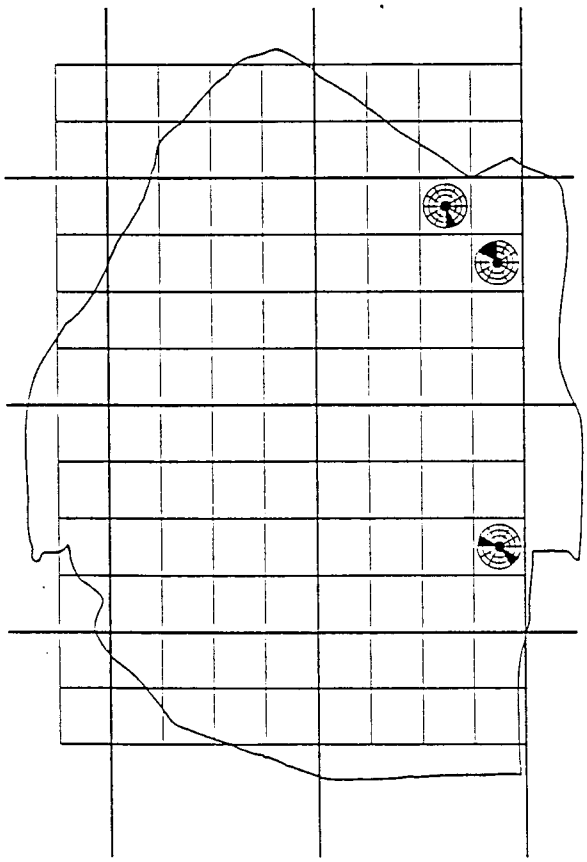


295. Blackwinged stilt. (Himantopus himantopus)

Recording frequency: 103 (/2263) 5%.
Population estimate: 100.
Status: Uncommon breeding resident in the middleveld and lowveld.
Habitat preference: Dams with extensive shallows.

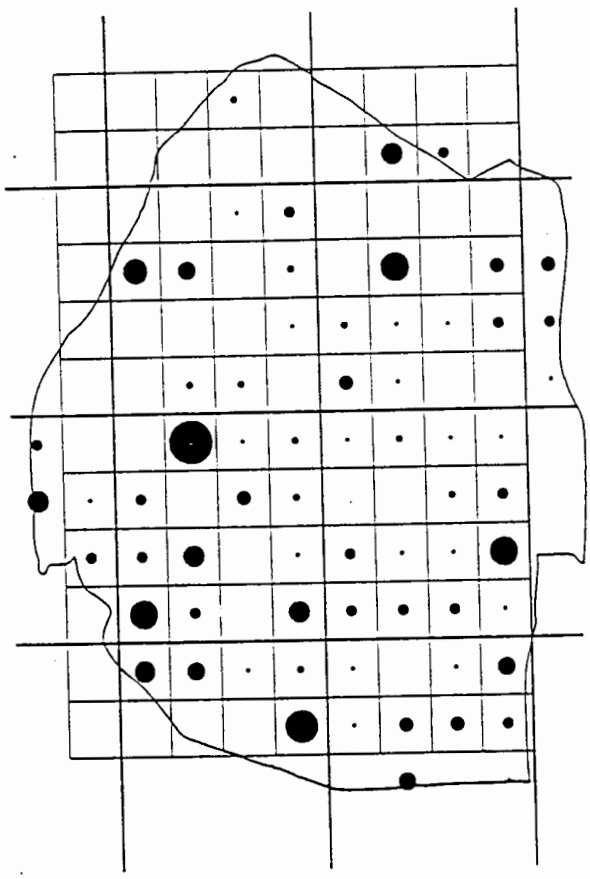


300. Temminck's courser. (Cursorius temminckii)
Recording frequency: 20 (/2263) 1%.
Population estimate: 40.
Status: Uncommon breeding resident.
Habitat preference: Grassland, savanna and cultivated lands.



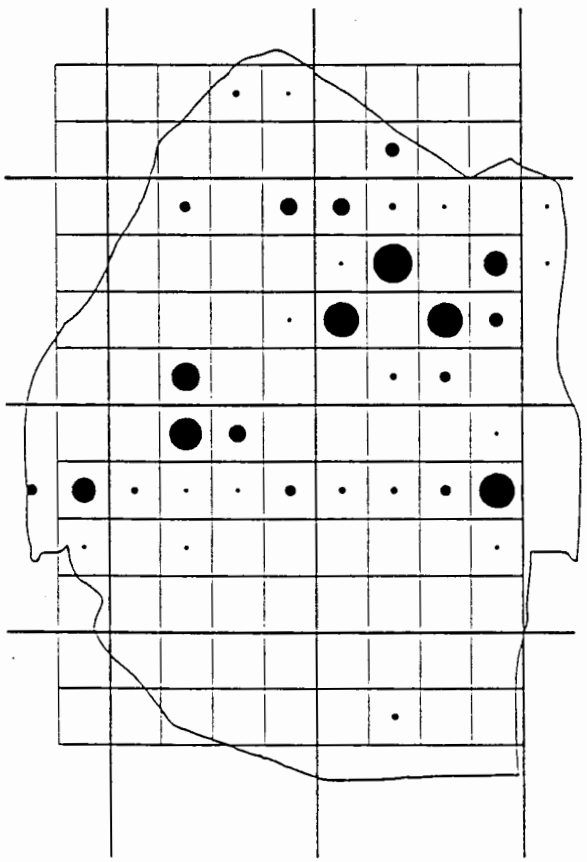
303. Bronzewinged courser. (Rhinoptilus chalcopterus)

Recording frequency: 6 (/2263) 0,35%.
Status: It is not clear whether the species is an uncommon visitor or a rare breeding resident in the lowveld. Due to its nocturnal habits and unobtrusiveness, is probably more widespread than indicated by the map.
Habitat preference: Woodland and savanna.



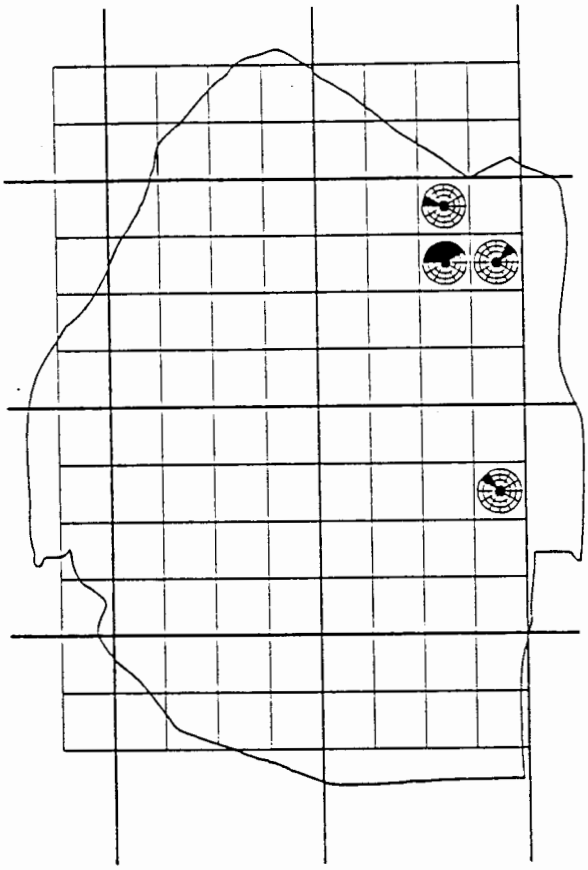
297. Spotted dikkop. (Burhinus capensis)

Recording frequency: 277 (/2263) 12%.
Population estimate: 800.
Status: Uncommon breeding resident.
Habitat preference: Grassland and savanna.



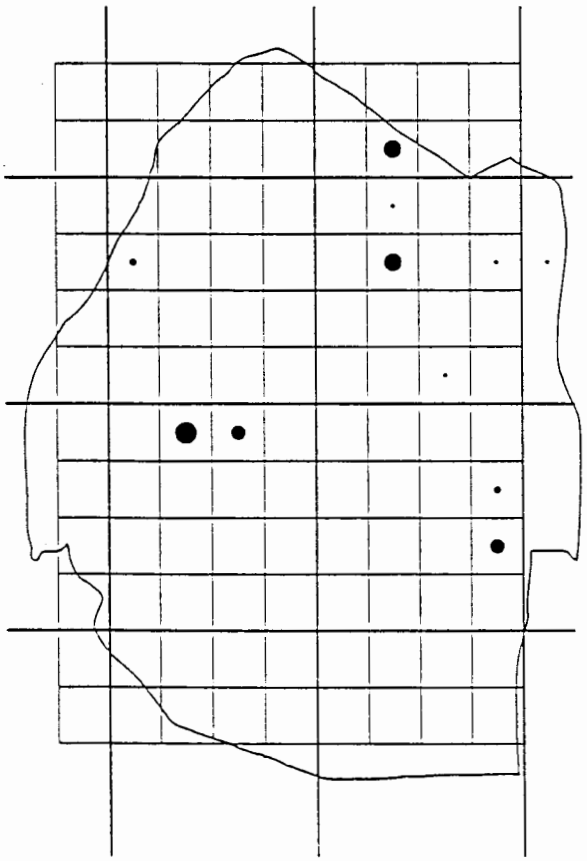
298. Water dikkop. (Burhinus vermiculatus)

Recording frequency: 163 (/2263) 7%.
Population estimate: 400.
Status: Uncommon breeding resident.
Habitat preference: Riverbanks and the shorelines of dams.

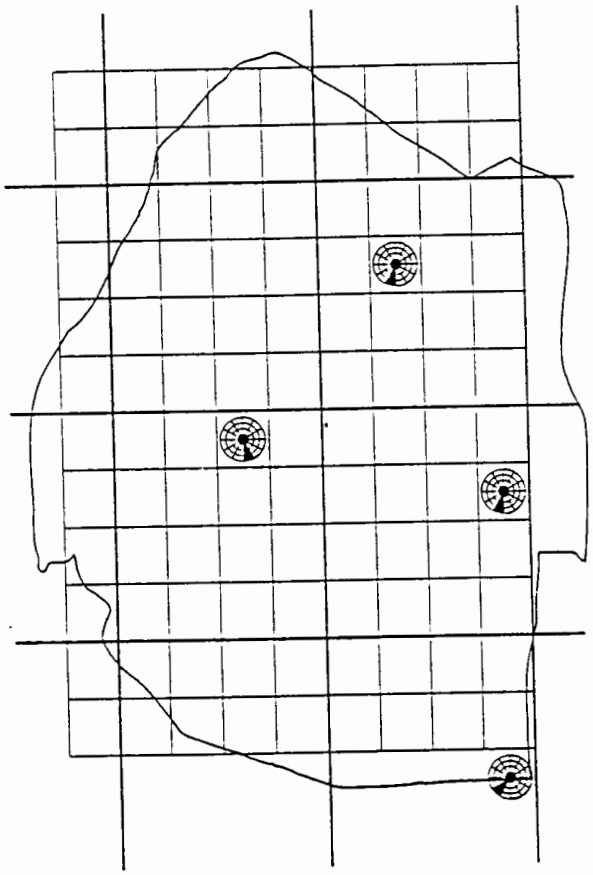


304. Redwinged pratincole. (Glareola pratincola)

Recording frequency: 7 (/2263) 0,35%.
Population estimate: 10.
Status: Rare breeding summer migrant.
Habitat preference: Has only been encountered among sugar cane fields. Has been observed breeding in fallow land among the cane fields at two different localities (M. Hoogewegen and T. & P. Sandiford).

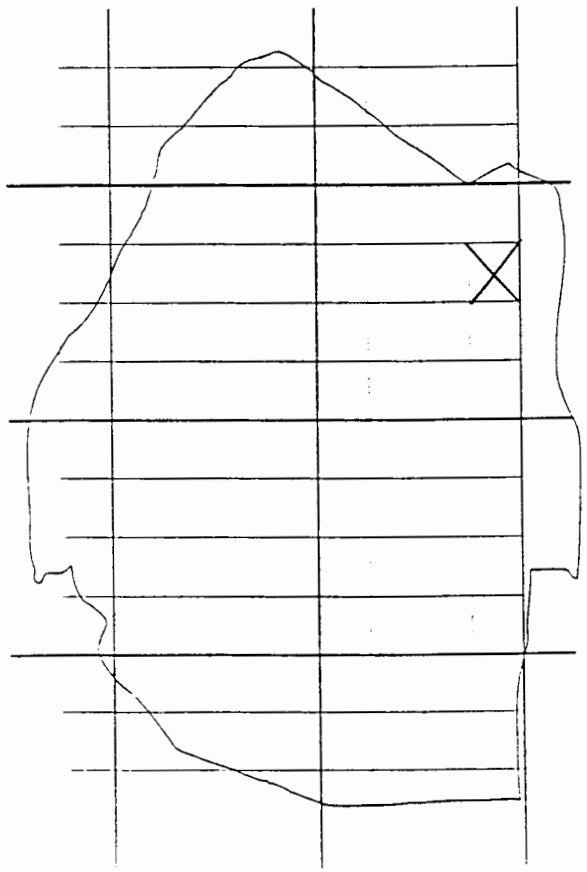


315. Greyheaded gull. (Larus cirrocephalus)
Recording frequency: 35(/2263) 2%.
Status: Uncommon visitor.
Habitat preference: Dams.



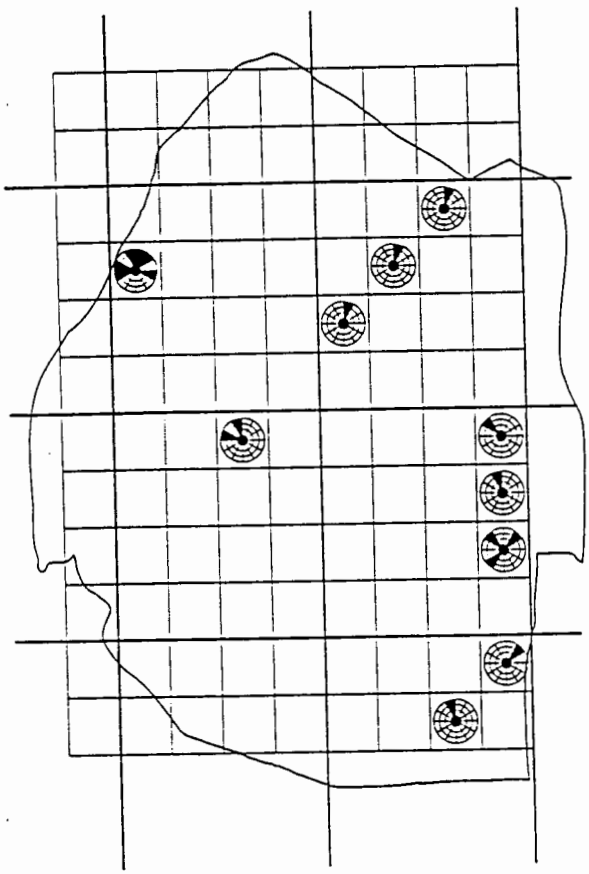
322. Caspian tern. (Hydroprogne caspia)

Single birds were seen at Sifunga (H10) in July 1986 (VP), at Jozini dam (M10) in August 1987 (VP), at Matshapa (G5) in July 1987 (VP) and at Mnjoli dam (D8) in July 1990 (VP).

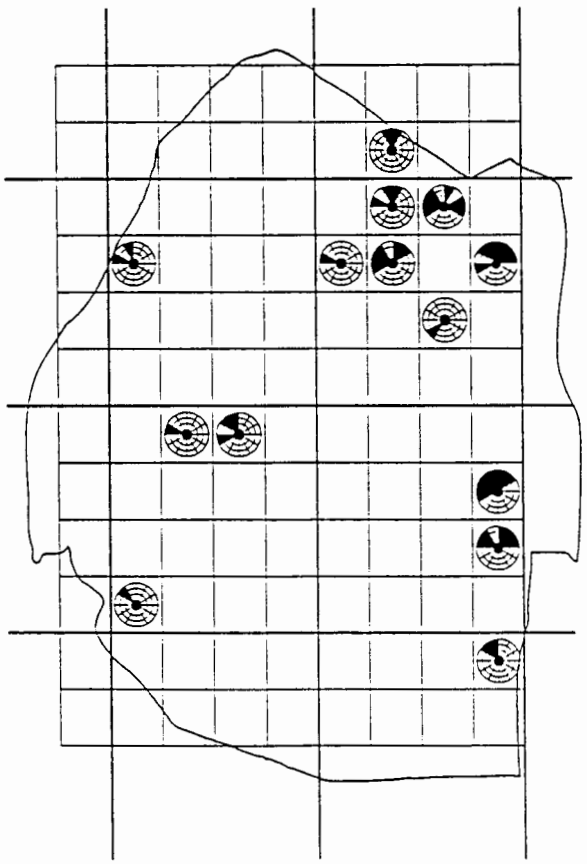


332. Sooty tern. (Sterna fuscata)

A single bird in an exhausted state was picked up at Mlawula (D10) by J. Culverwell in February 1984, in the aftermath of Cyclone Demoina.

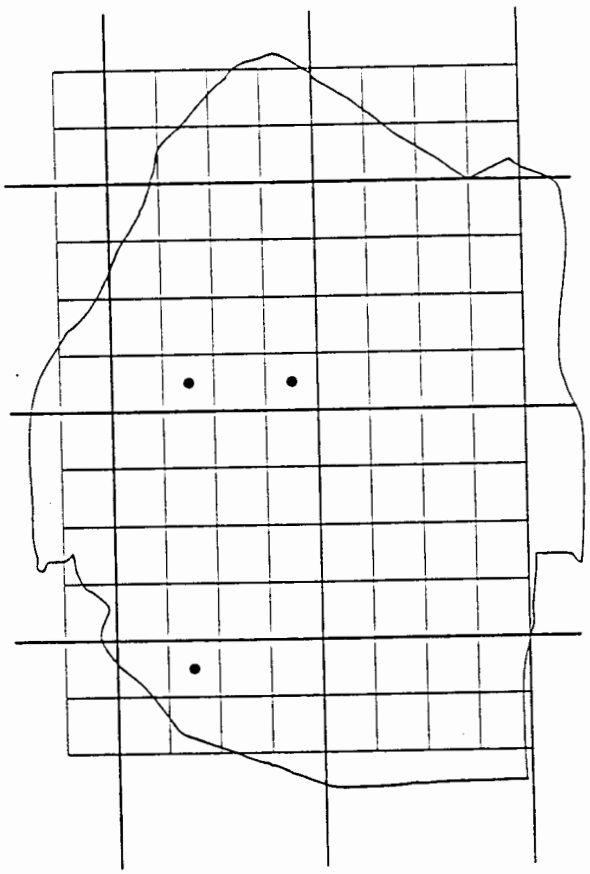


338. Whiskered tern. (Chlidonias hybridus)
Recording frequency: 22 (/2263) 1%.
Population estimate: 10.
Status: Uncommon breeding summer migrant, usually encountered in pairs.
Habitat preference: Dams.



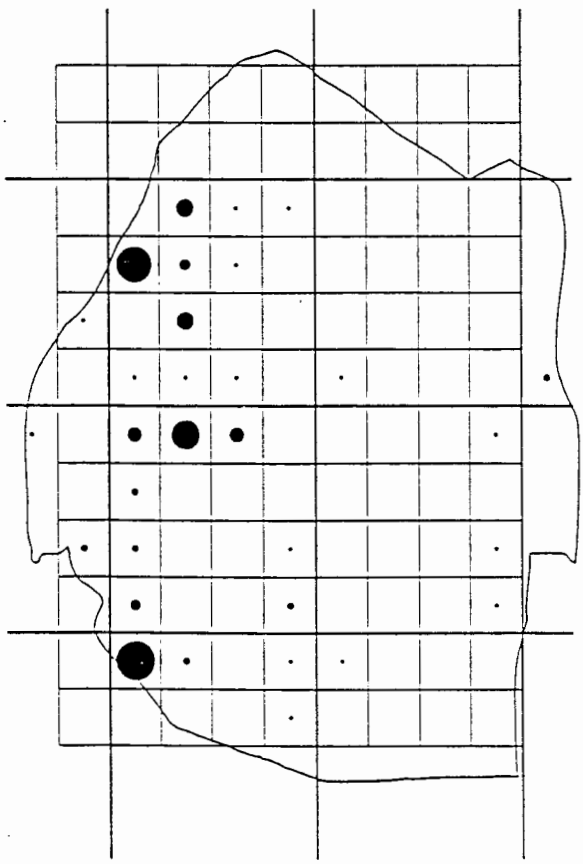
339. Whitewinged tern. (Chlidonias leucopterus)

Recording frequency: 47 (/2263) 2%.
Status: Uncommon summer migrant, encountered in small flocks of up to 20 birds.
Habitat preference: Dams.



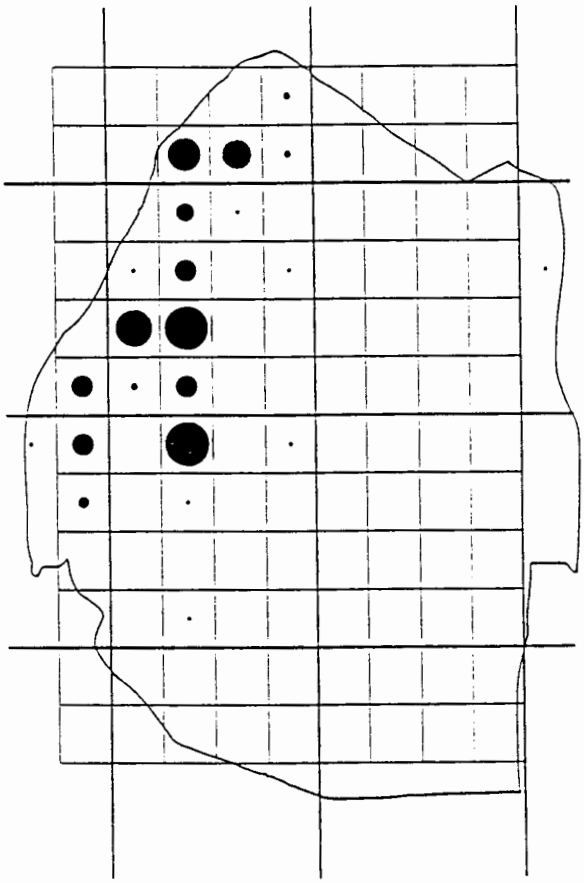
348. Feral pigeon. (Columba livia)

The distribution of this species has not been mapped due to uncertainty as to which birds are truly feral. Birds that are kept in a semi-domesticated state are encountered in many rural areas. Birds that are truly feral occur at least in Manzini (F6), Mahlanya (F4) and Nhlangano (K4). Feral birds used to occur in Mbabane (E4) (J. Culverwell, pers. comm.), but have unaccountably disappeared from the town.



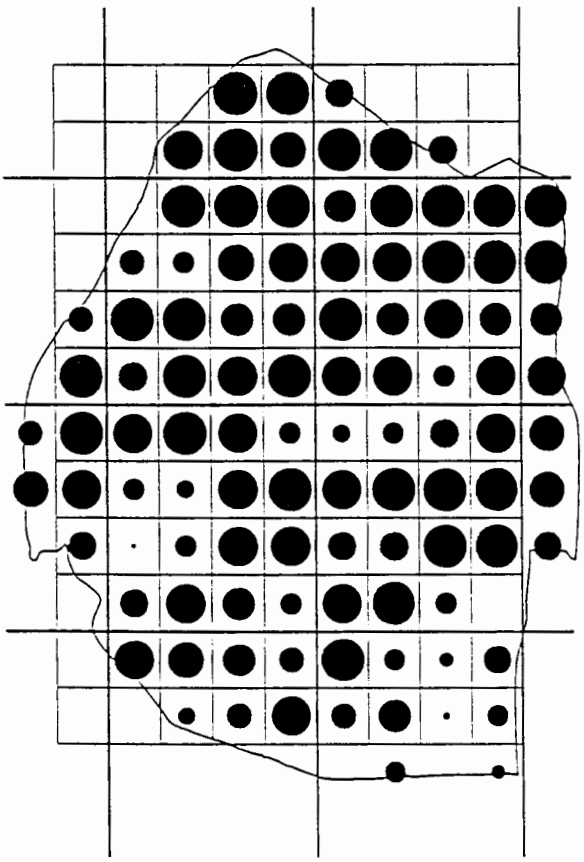
349. Rock pigeon. (Columba guinea)

Recording frequency: 87 (/2263) 4%.
Population estimate: 2 000.
Status: A common breeding resident in the highveld and an uncommon visitor in the eastern lowveld and Lubombos.
Habitat preference: Breeds on cliffs and forages in grassland and cultivated lands.



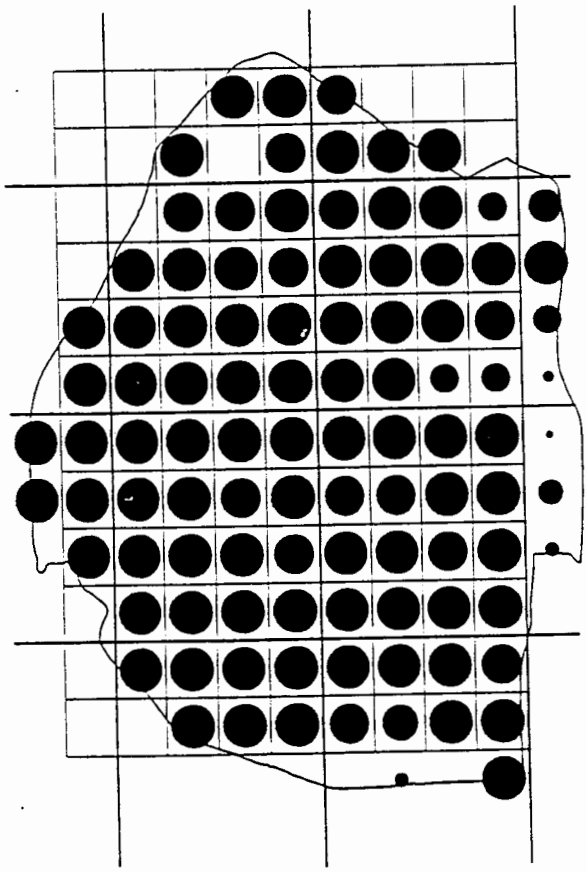
350. Rameron pigeon. (Columba arquatrix)

Recording frequency: 175 (/2263) 8 %.
Population estimate: 4 000.
Status: A common breeding resident in the highveld and vagrant in the Lubombos.
Habitat preference: Most common in pine plantations where it feeds on the fruit of the weed solanum mauritianum. Also occurs in natural forest and woodland.



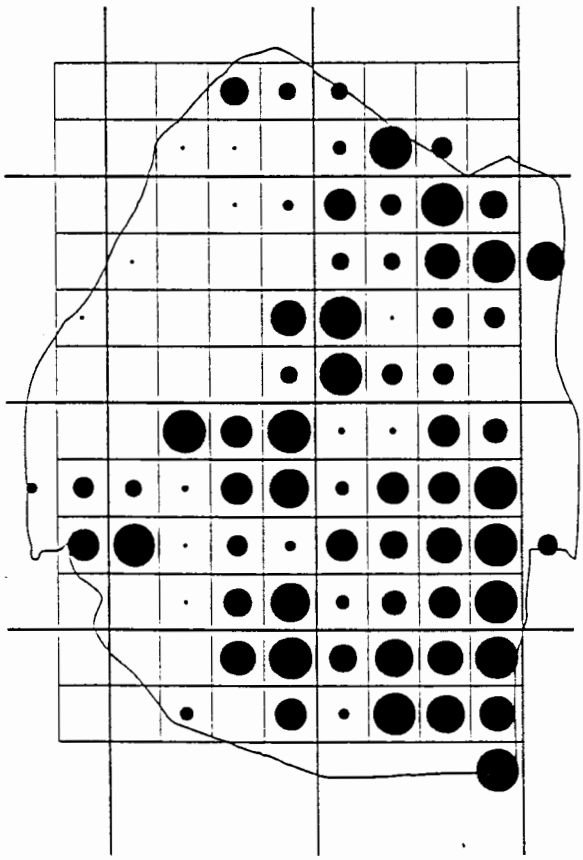
352. Redeyed dove. (Streptopelia semitorquata)

Recording frequency: 1 417 (/2263) 63%.
Population estimate: 20 000.
Status: Very common breeding resident, more common in the north than in the south.
Habitat preference: Forest and woodland.



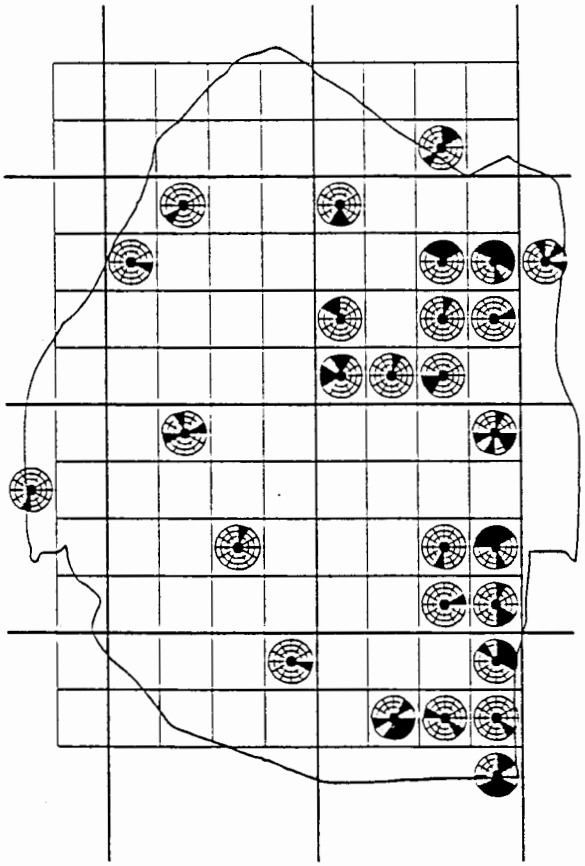
354. Cape turtle dove. (Streptopelia capicola)

Recording frequency: 1 845 (/2263) 82%.
Population estimate: 40 000.
Status: A very common breeding resident in most areas but is absent from the Rocklands grid unit (B5) and is uncommon in the Lubombos.
Habitat preference: Occurs in all habitats except forest.



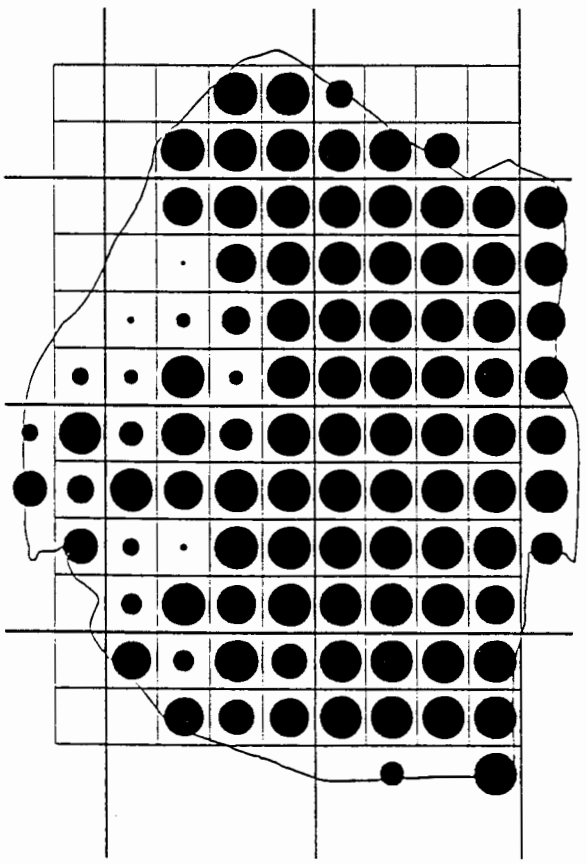
355. Laughing dove. (Streptopelia senegalensis)

Recording frequency: 745 (/2263) 33%.
Population estimate: 7 000.
Status: A common breeding resident in the lowveld and middleveld and a vagrant in the highveld.
Habitat preference: Savanna.



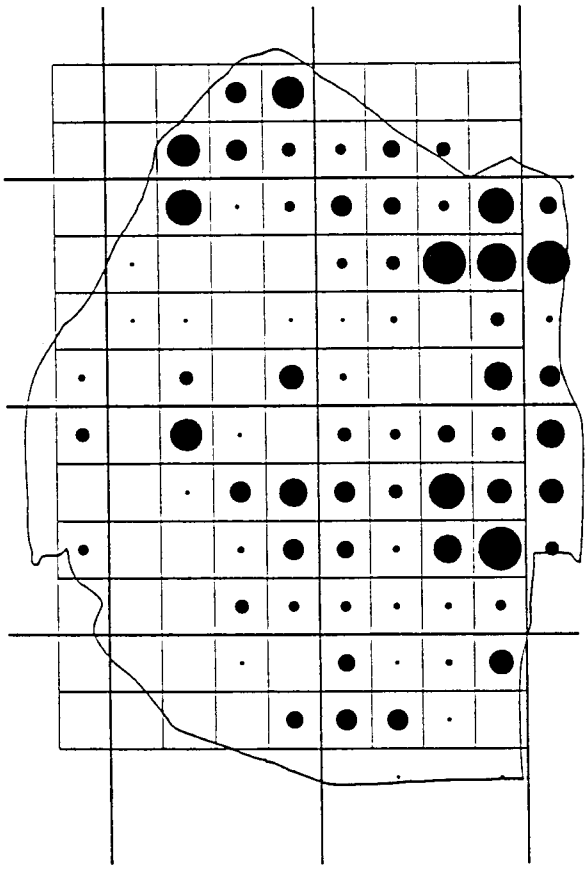
356. Namaqua dove. (Oena capensis)

Recording frequency: 84 (/2263) 4%.
Population estimate: 200.
Status: Uncommon breeding species which appears to be resident in the southern lowveld, mostly a summer visitor to the northern lowveld and a vagrant elsewhere.
Habitat preference: Savanna.



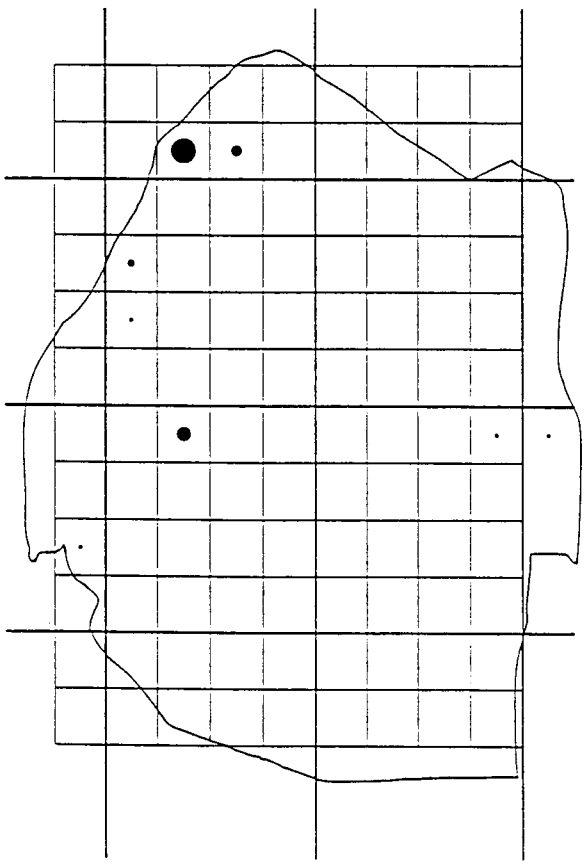
358. Greenspotted dove. (Turtur chalcospilos)

Recording frequency: 1 619 (/2263) 72%.
Population estimate: 30 000.
Status: A very common breeding resident in most parts, but uncommon in the southern highveld and a vagrant in the northern highveld.
Habitat preference: Woodland and savanna.



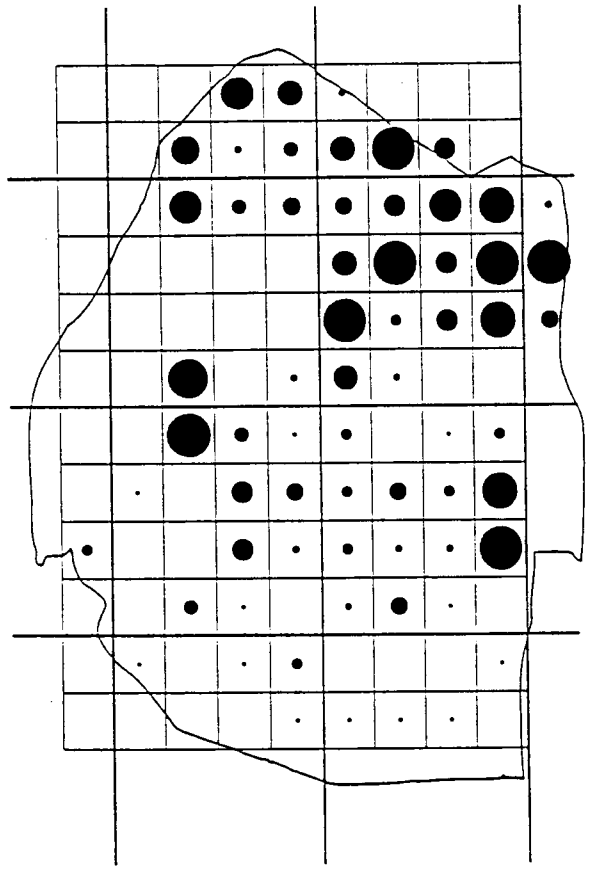
359. Tambourine dove. (Turtur tympanistria)

Recording frequency: 445 (/2263) 20%.
Population estimate: 4 000.
Status: A common breeding resident in the eastern lowveld and Lubombos, absent from the southern highveld and uncommon elsewhere.
Habitat preference: Woodland and forest.



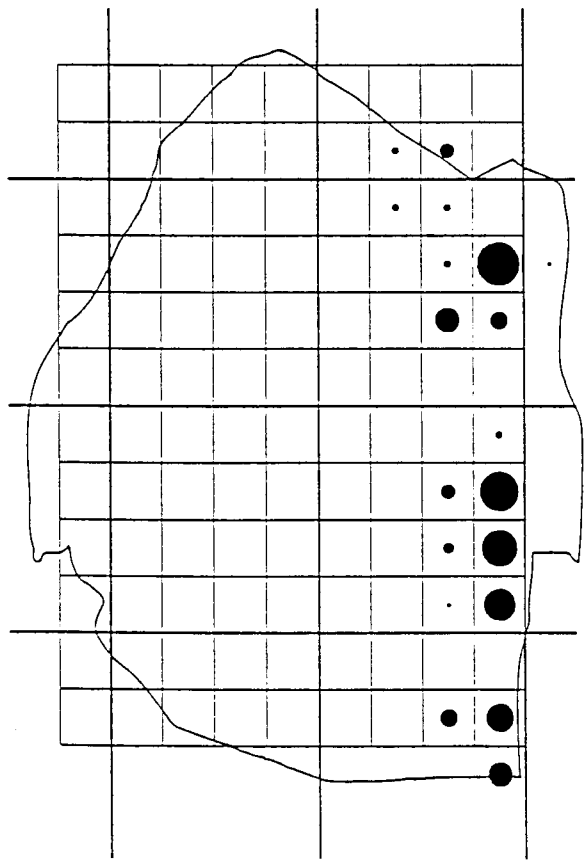
360. Cinnamon dove. (Aplopelia larvata)

Recording frequency: 23 (/2263) 1%.
Population estimate: 100.
Status: Uncommon breeding resident in the highveld and Lubombos. Due to its unobtrusiveness it may be more widespread than indicated by the map.
Habitat preference: Forest.



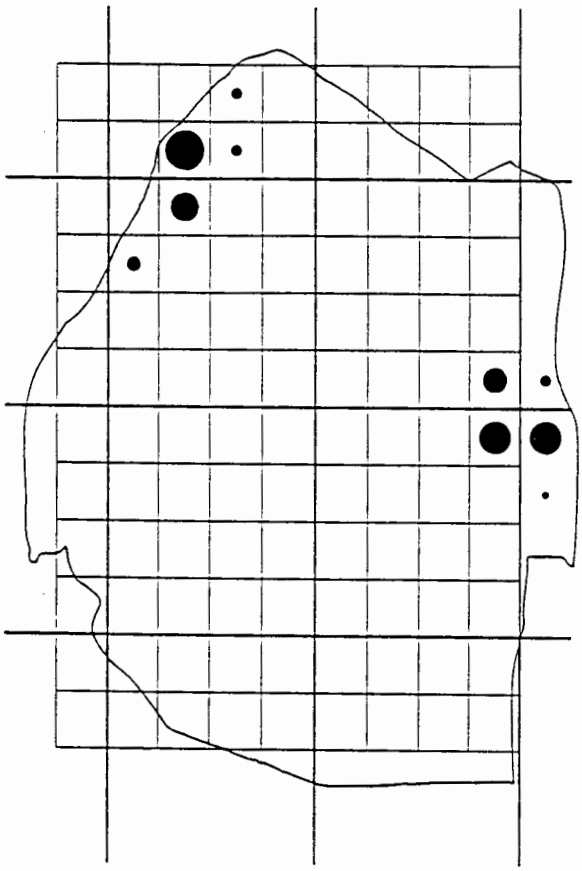
361. Green pigeon. (Treron calva)

Recording frequency: 546 (/2263) 24%.
Population estimate: 3 000.
Status: A common breeding resident in the middleveld, lowveld and Lubombos. More common in the north than the south.
Habitat preference: Woodland.



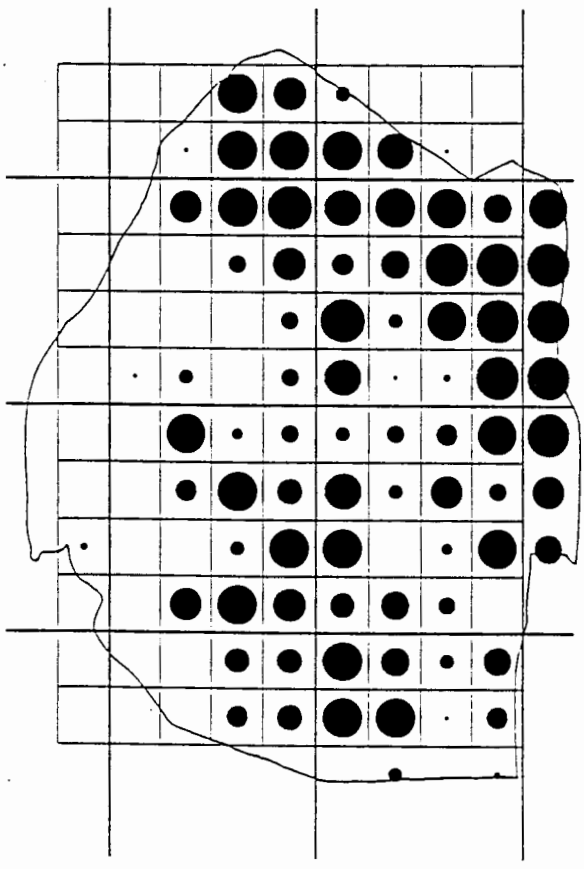
363. Brownheaded parrot. (Poicephalus cryptoxanthus)

Recording frequency: 140 (/2263) 6%.
Population estimate: 400.
Status: Uncommon breeding resident in the eastern lowveld.
Habitat preference: Knobthorn-marula savanna.



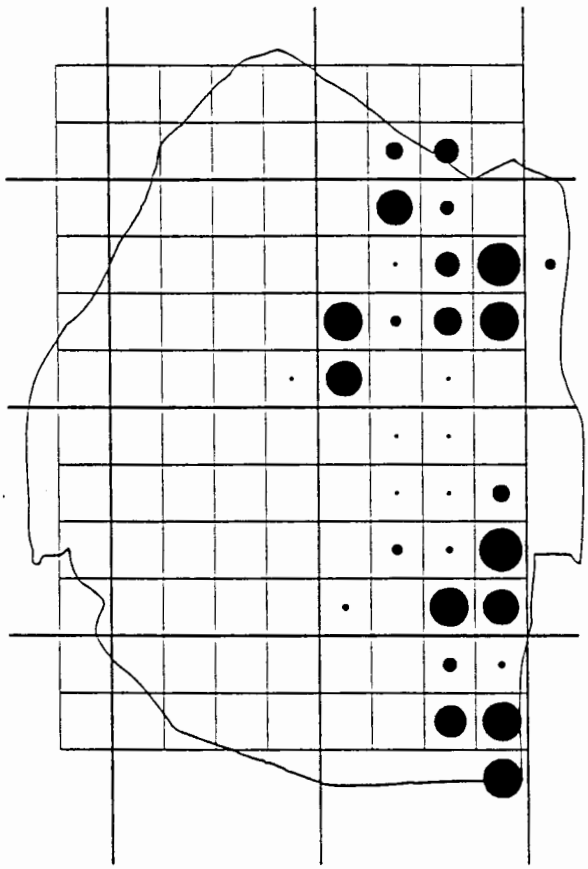
370. Knysna lourie. (Tauraco corythaix)

Recording frequency: 73 (/2263) 3%.
Population estimate: 400.
Status:Uncommon breeding resident in the northern highveld and central Lubombos. The highveld birds are of the subspecies T. c. corythaix and those in the Lubombos of the subspecies T. c. schalowi.
Habitat preference: Forest.



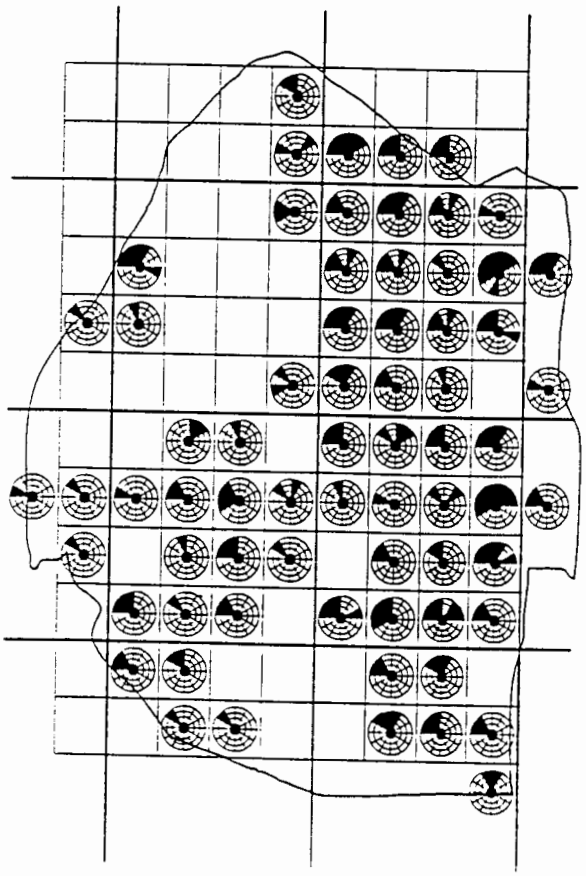
371. Purplecrested lourie. (Tauraco porphyreolophus)

Recording frequency: 840 (/2263) 37%.
Population estimate: 2 000.
Status: Common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland.



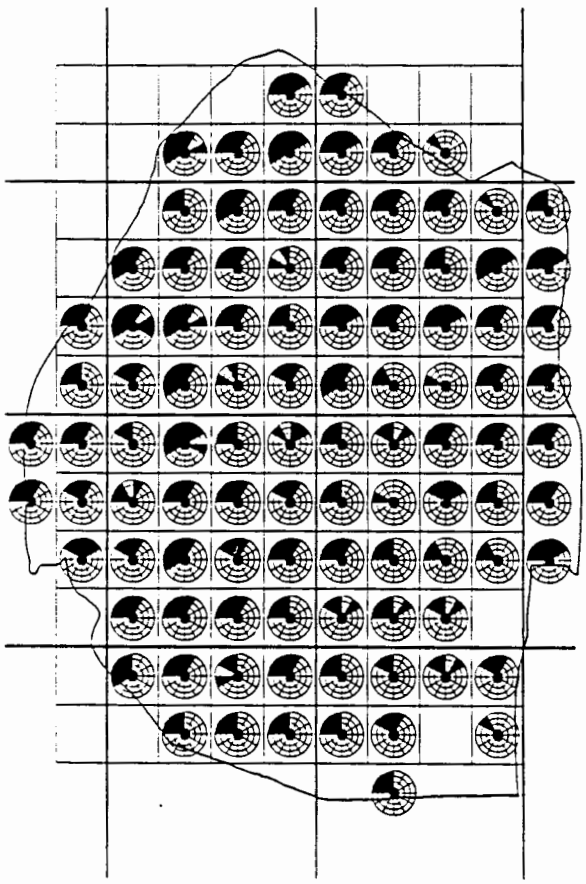
373. Grey lourie. (Corythaixoides concolor)

Recording frequency: 277 (/2263) 12%.
Population estimate: 400.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Thorn savanna.



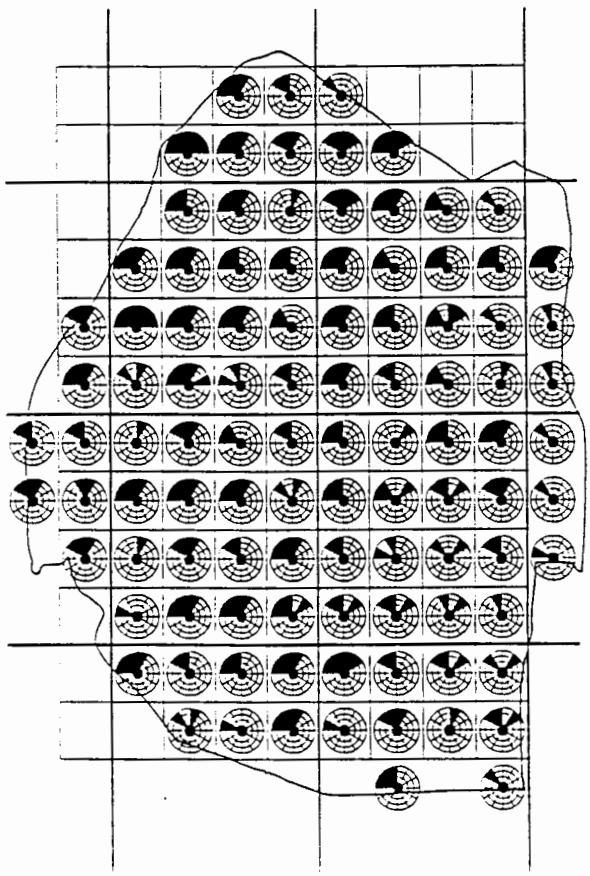
375. African cuckoo. (Cuculus gularis)

Recording frequency: 196 (/2263) 9%.
Population estimate: 1 000.
Status: Common breeding summer migrant, occasionally overwintering.
Habitat preference: Woodland and savanna. Occurs in wattle stands in the highveld.



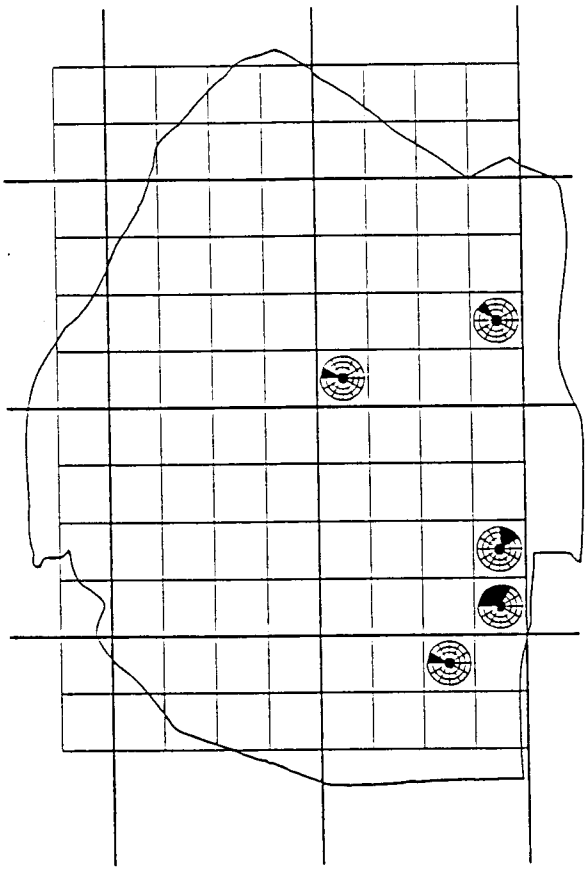
377. Redchested cuckoo. (Cuculus solitarius)

Recording frequency: 541 (/2263) 24%.
Population estimate: 4 000.
Status: A very common breeding summer migrant in most regions but uncommon in the southern lowveld. Commences calling earlier in the highveld (September) than in the lowveld (October). Usually ceases calling during January and is then very difficult to detect and is consequently under recorded in the late summer months.
Habitat preference: Forest, woodland, wattle stands and savanna.



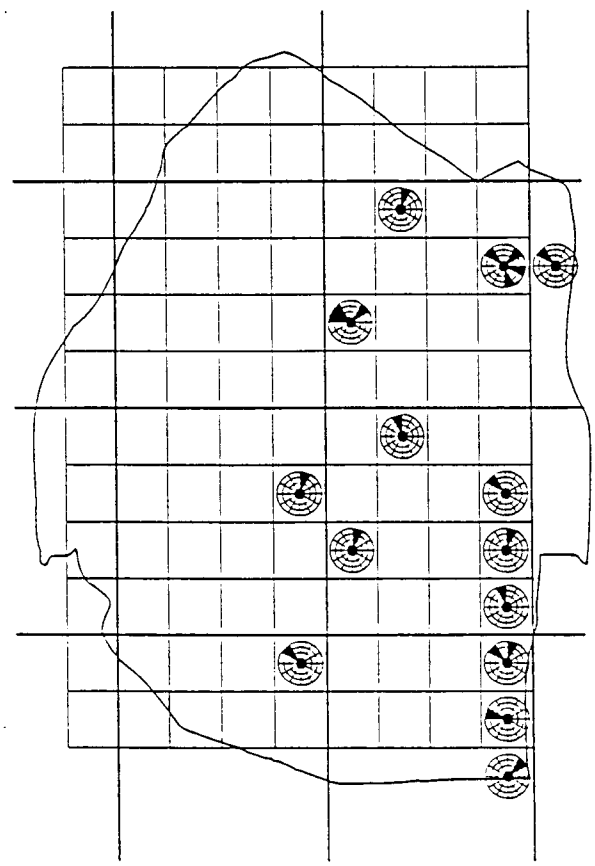
378. Black cuckoo. (Cuculus clamosus)

Recording frequency: 352 (/2263) 16%.
Population estimate: 3 000.
Status: Common breeding summer migrant.
Habitat preference: Forest, woodland, wattle stands and savanna.



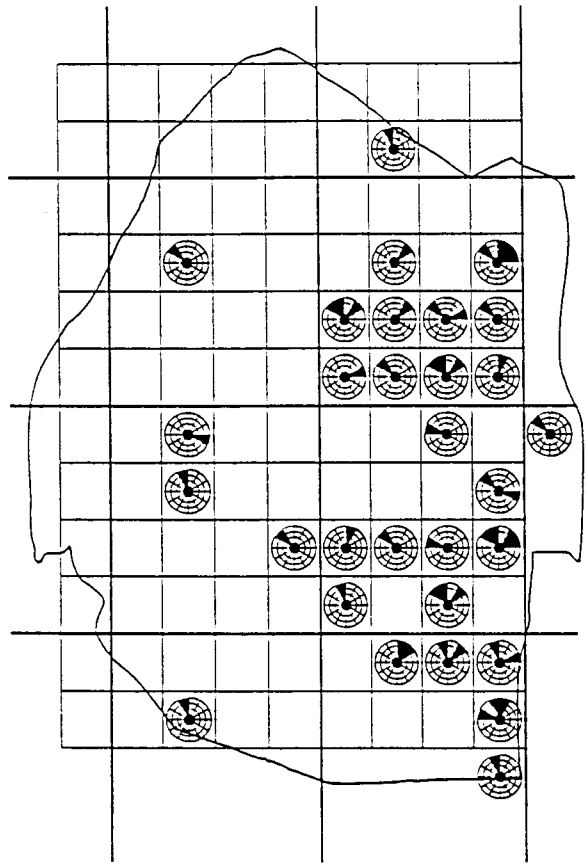
380. Great spotted cuckoo. (Clamator glandarius)

Recording frequency: 9 (/2263) 0,45%.
Population estimate: 10.
Status: Uncommon breeding summer migrant in the eastern lowveld. Its distribution coincides closely with that of Burchell's starling, presumably the major if not only host species for the great spotted cuckoo in Swaziland. (The pied crow has not been recorded breeding in the areas inhabited by the great spotted cuckoo).
Habitat preference: Knobthorn-marula savanna.



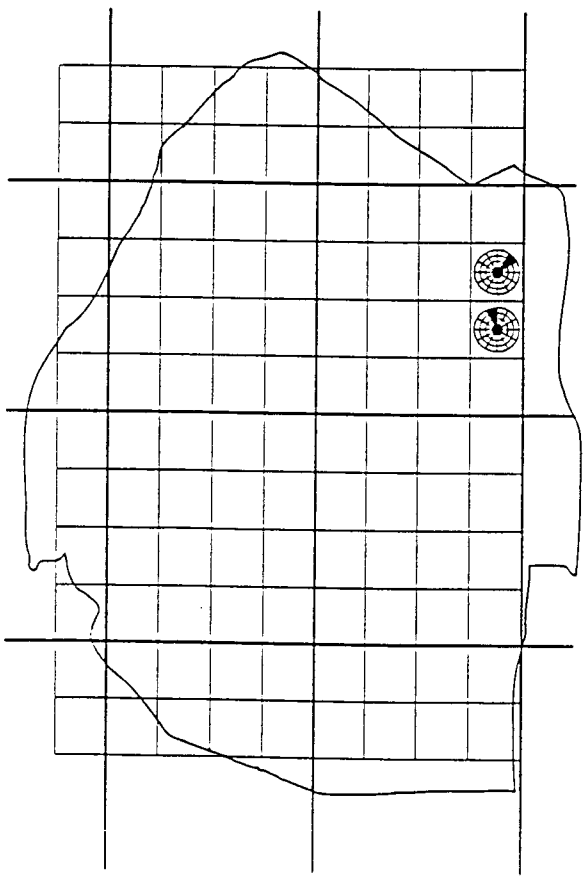
381. Striped cuckoo. (Clamator levaillantii)

Recording frequency: 23 (/2263) 1%.
Population estimate: 50.
Status: Uncommon breeding summer migrant in the lowveld. Due to its close similarity to the Jacobin cuckoo (especially in vocalisations) it has been under recorded and can be assumed to be more widespread and common than indicated.
Habitat preference: Acacia woodland and savanna.



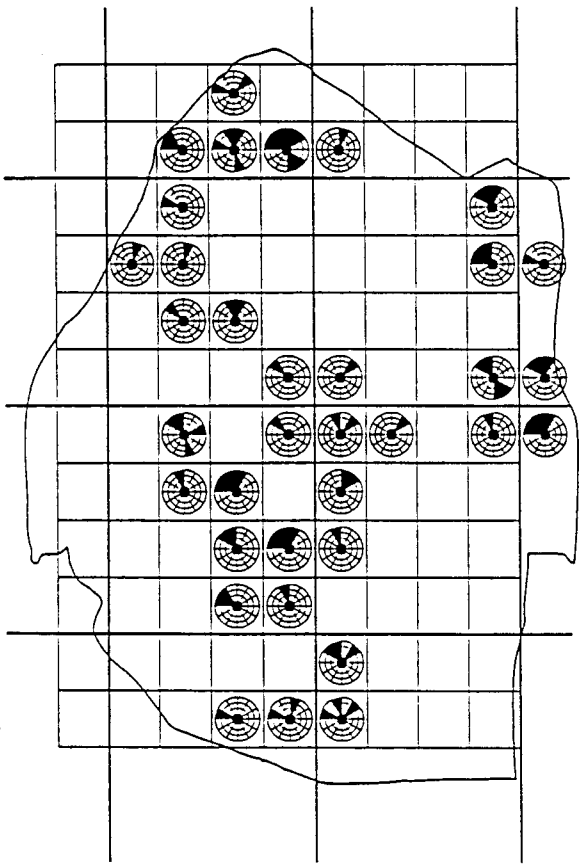
382. Jacobin cuckoo. (Clamator jacobinus)

Recording frequency: 54 (/2263) 2%.
Population estimate: 600.
Status: Uncommon breeding summer migrant in the middleveld, lowveld and Lubombos. Probably more common and widespread in the lowveld than indicated (see previous species).
Habitat preference: Woodland and savanna.



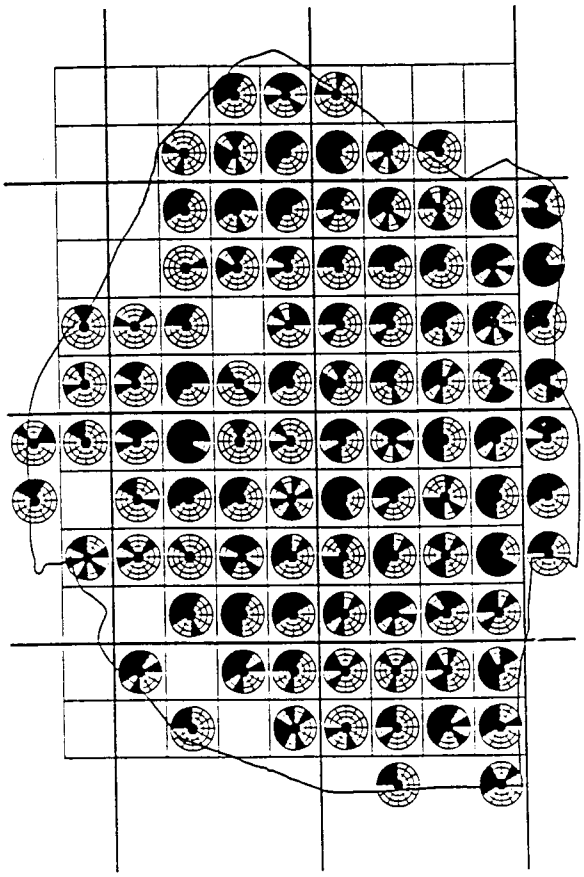
383. Thickbilled cuckoo. (Pachycoccyx audeberti)

Recording frequency: 2 (/2263) 0,1 %.
Population estimate: 2.
Status: Probably a rare breeding summer migrant at Mlawula (C10) in the north east.
Habitat preference: Woodland.



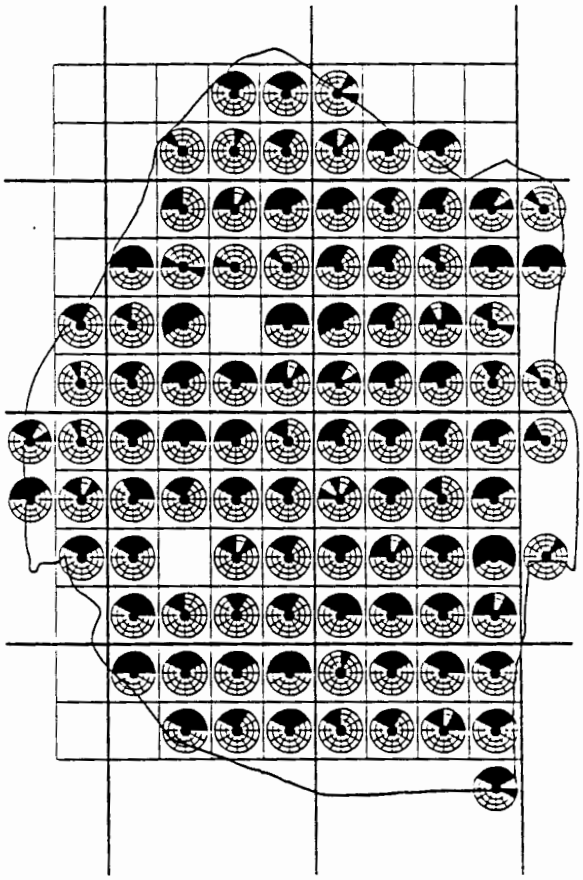
384. Emerald cuckoo. (Chrysococcyx cupreus)

Recording frequency: 79 (/2263) 3%.
Population estimate: 300.
Status: It is not clear wether the species is an uncommon resident or a breeding summer migrant, as some birds are encountered in winter months and it is easily overlooked when not calling.
Habitat preference: Forest and woodland.



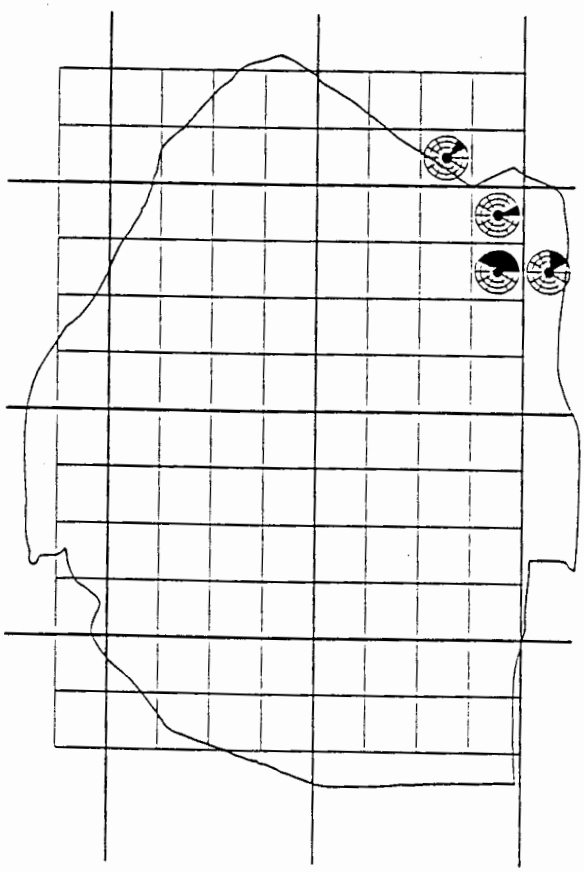
385. Klaas's cuckoo. (Chrysococcyx klaas)

Recording frequency: 650 (/2263) 29%.
Population estimate: 1 000.
Status: Common breeding resident. There are relatively few records between March and July, as the species is difficult to detect when not calling.
Habitat preference: Woodland and savanna.



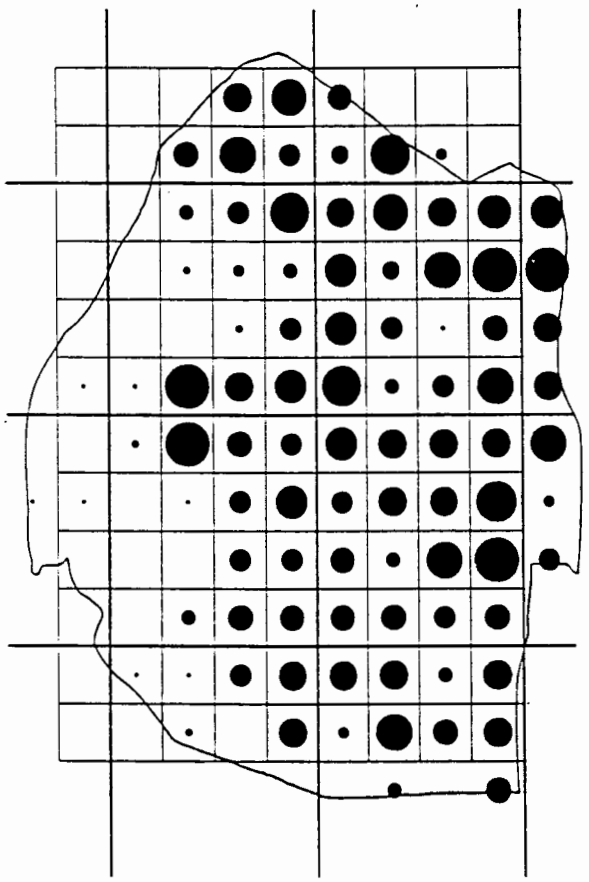
386. Diederik cuckoo. (Chrysococcyx caprius)

Recording frequency: 495 (/2263) 22%.
Population estimate: 1 000.
Status: Common breeding summer migrant.
Habitat preference: Vleis, grassland and savanna.



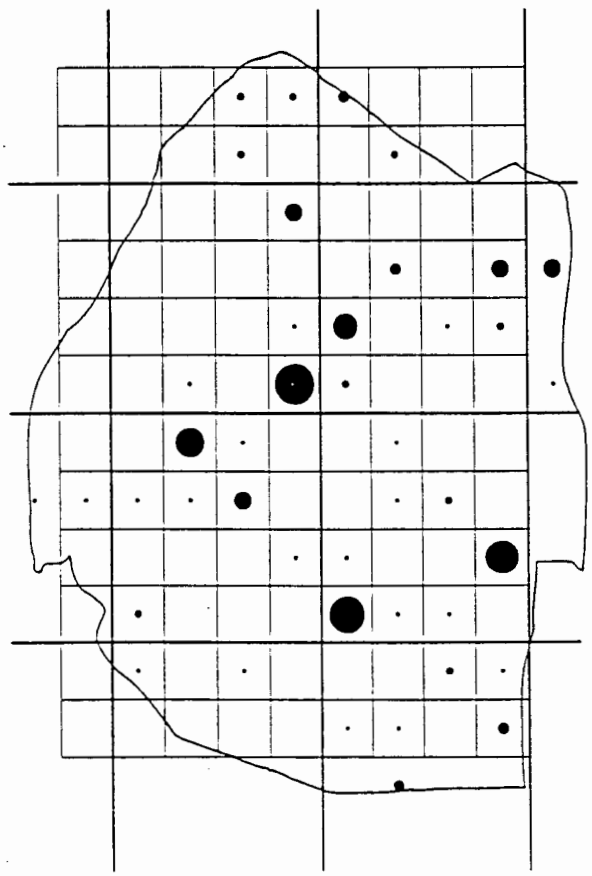
388. Black coucal. (Centropus bengalensis)

Recording frequency: 11 (/2263) 0,5%.
Population estimate: 10.
Status: Rare breeding summer migrant in the northern lowveld.
Habitat preference: Woodland with rank grass.



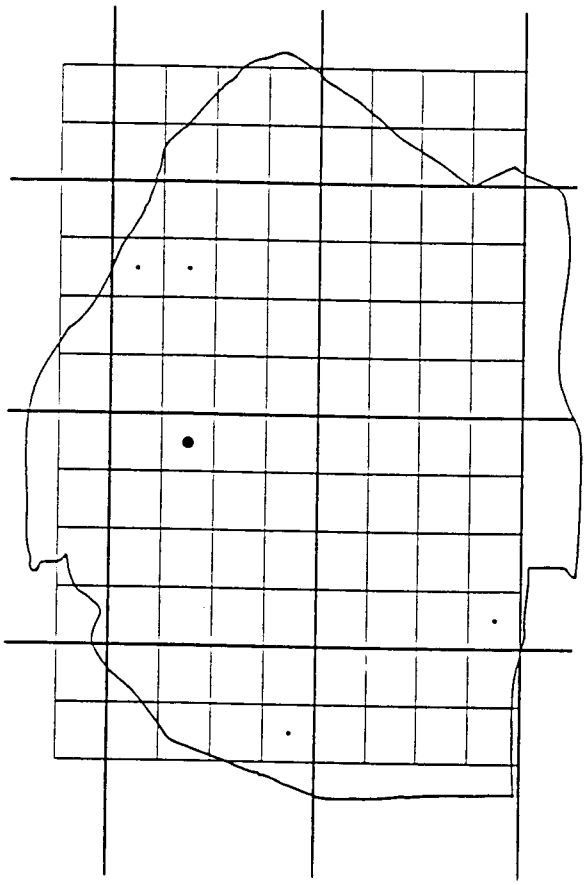
391. Burchell's coucal. (Centropus superciliosus)

Recording frequency: 902 (/2263) 40%.
Population estimate: 2 000.
Status: Common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland, usually near streams or vleis.



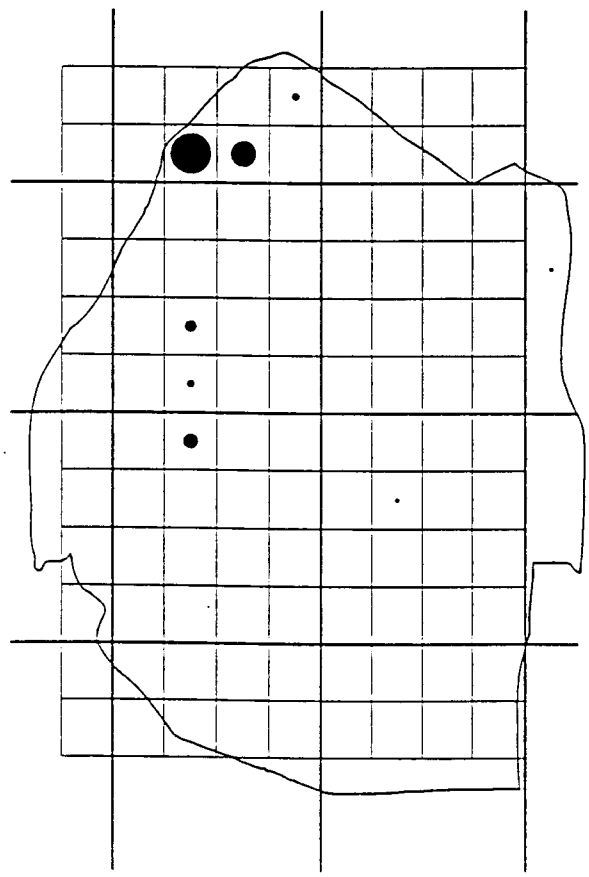
392. Barn owl. (Tyto alba)

Recording frequency: 130 (/2263) 6%.
Population estimate: 1 000.
Status: Uncommon breeding resident.
Habitat preference: Encountered in all habitat types.



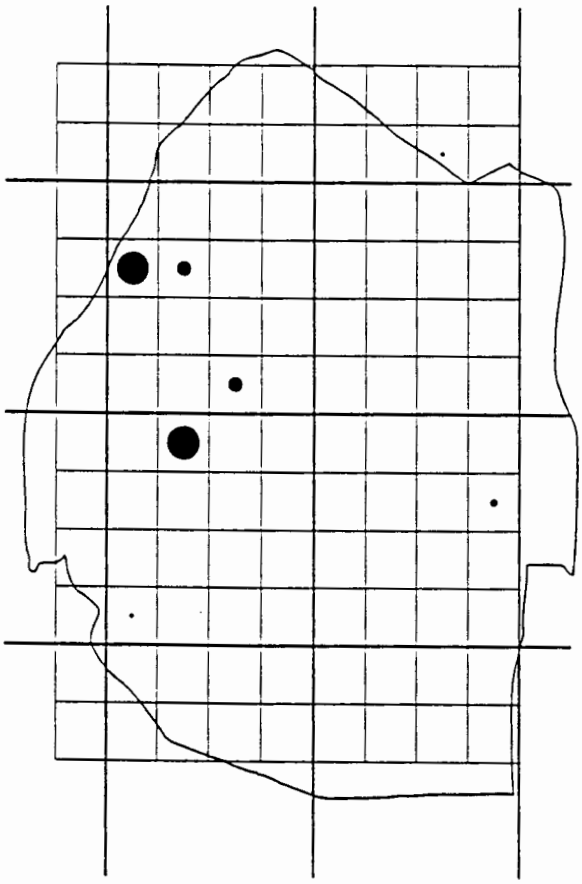
393. Grass owl. (Tyto capensis)

Recording frequency: 7 (/2263) 0,35%.
Population estimate: 20.
Status: Rare breeding resident.
Habitat preference: Vleis and rank grass.

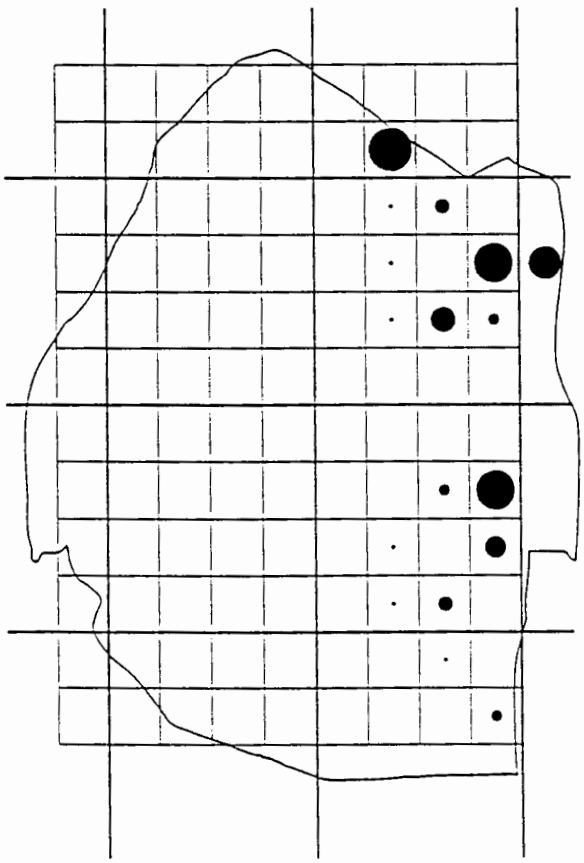


394. Wood owl. (Strix woodfordii)

Recording frequency: 33 (/2263) 1%.
Population estimate: 100.
Status: Uncommon breeding resident.
Habitat preference: Woodland and forest.

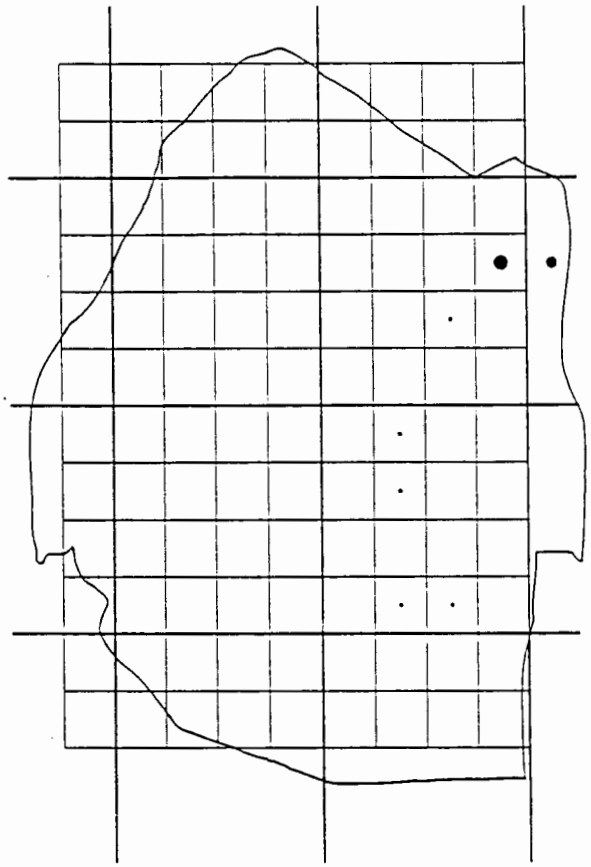


395. Marsh owl. (Asio capensis)
Recording frequency: 43 (/2263) 2%.
Population estimate: 100.
Status: Uncommon breeding resident.
Habitat preference: Vleis.



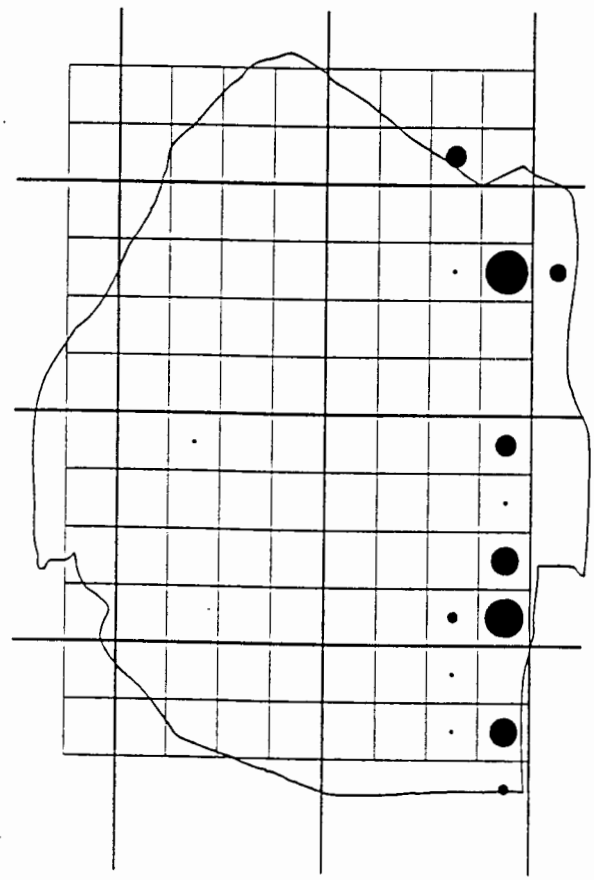
396. Scops owl. (Otus senegalensis)

Recording frequency: 124 (/2263) 5%.
Population estimate: 2 000.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Acacia woodland and savanna.



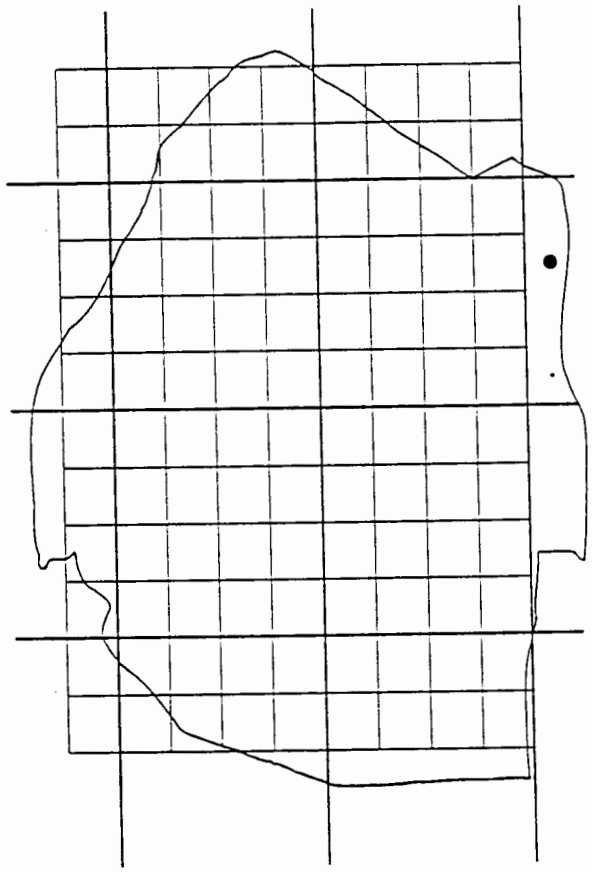
397. Whitefaced owl. (Otus leucotis)

Recording frequency: 13 (/2263) 1%.
Population estimate: 100.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Acacia woodland and savanna.



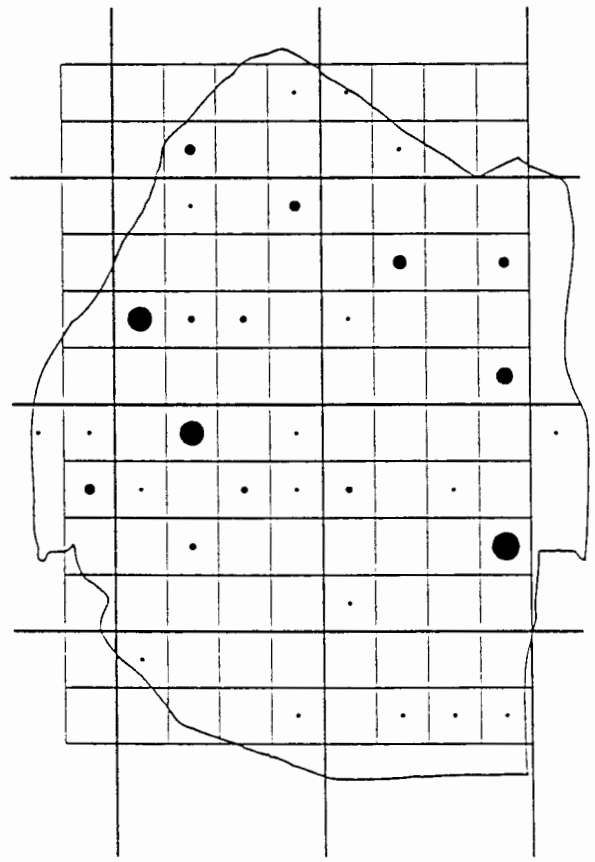
398. Pearlspotted owl. (Glaucidium perlatum)

Recording frequency: 82 (/2263) 4%.
Population estimate: 400.
Status: Uncommon breeding resident in the eastern lowveld.
Habitat preference: Knobthorn-marula savanna.



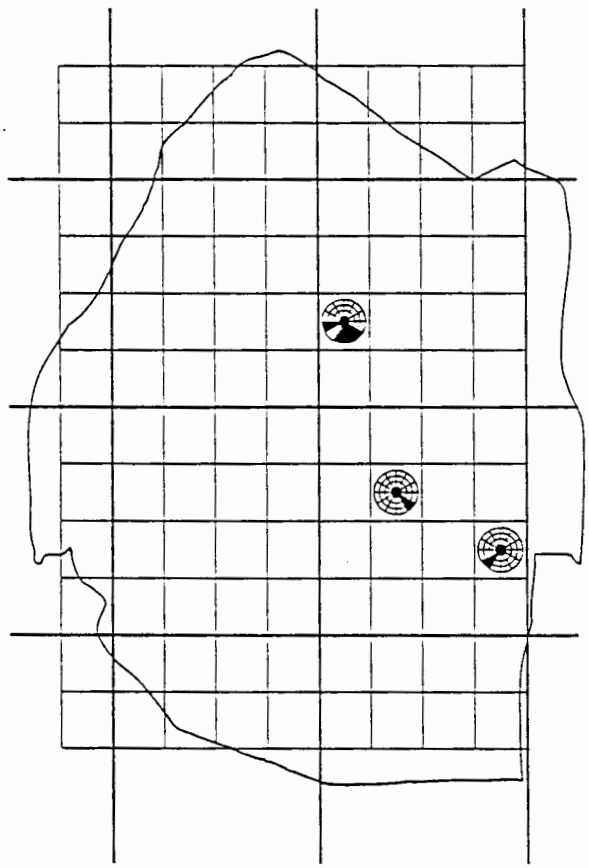
399. Barred owl. (Glaucidium capense)

Recording frequency: 6 (/2263) 0,3%.
Population estimate: 20.
Status: Rare breeding resident in the Lubombos.
Habitat preference: Forest.



401. Spotted eagle owl. (Bubo africanus)

Recording frequency: 89 (/2263) 4%.
Population estimate: 500.
Status: Uncommon breeding resident.
Habitat preference: Encountered in all habitat types.

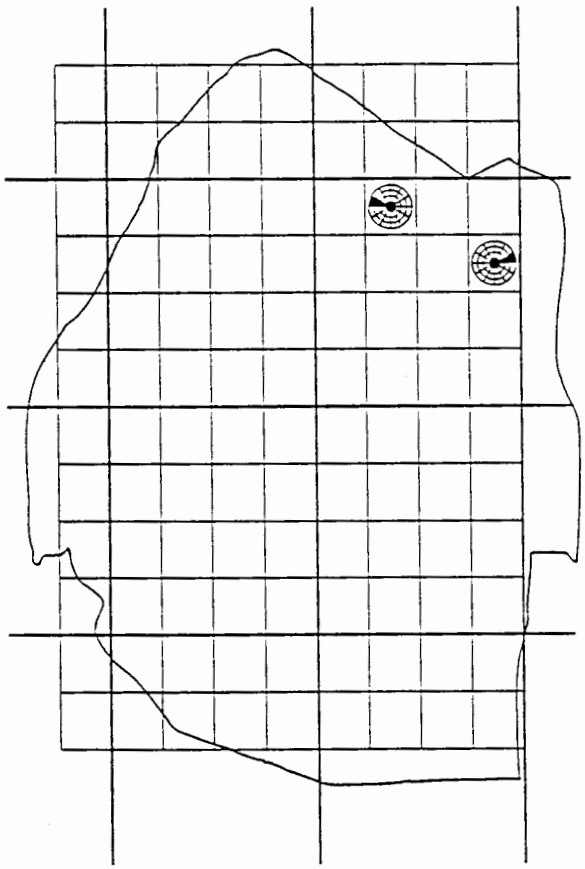


402. Giant eagle owl. (Bubo lacteus)

Recording frequency: 8 (/2263) 0,4%.
Population estimate: 10.
Status: Rare breeding resident in the lowveld.
Habitat preference: Riverine woodland.

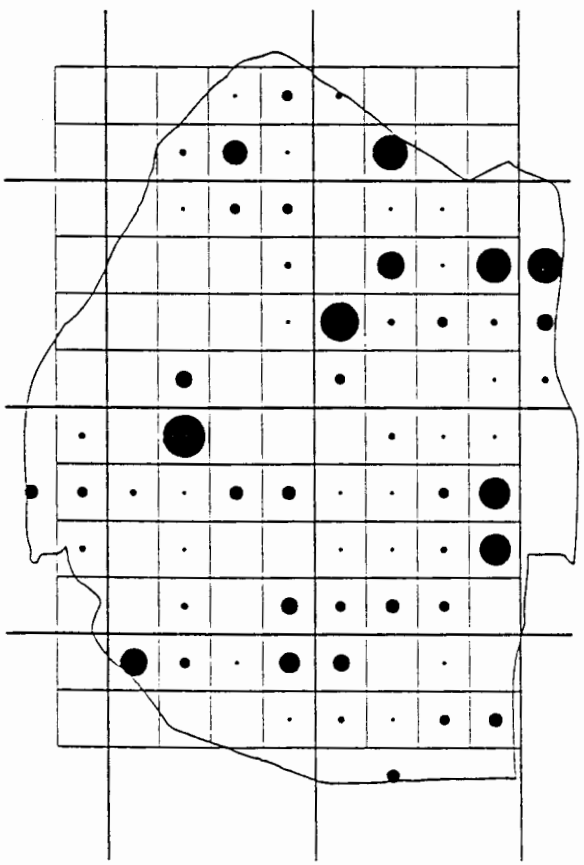
403. Pel's fishing owl. (Scotopelia peli)

Prior to 1984, this species was considered to be a breeding resident in the Umbuluzi gorge (D11) and possibly other river gorges in the Lubombos. However, it has not been encountered since February 1984 when most of the riverine forest in the gorge was swept away by floods in the aftermath of cyclone Demoina.



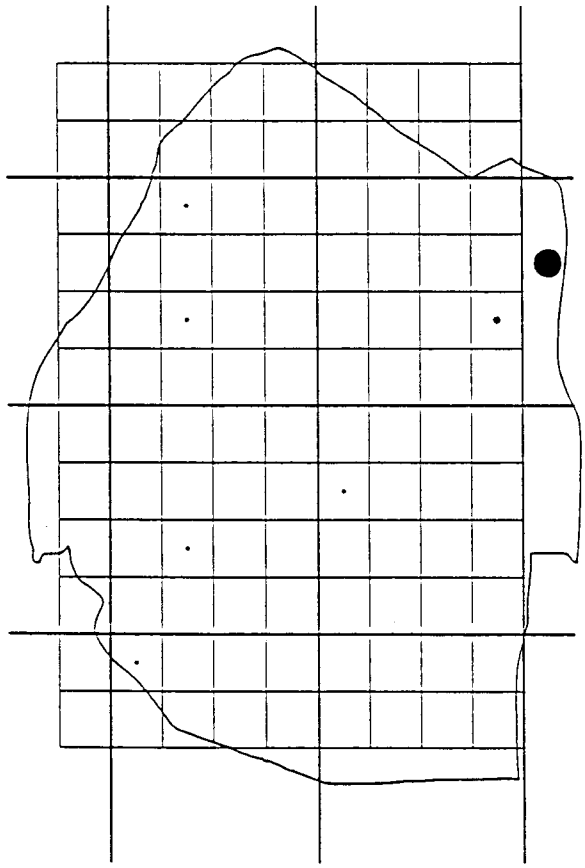
404. European nightjar. (Caprimulgus europaeus)

Recording frequency: 2 (/2263) 0,1%.
Status: Rare summer migrant in the lowveld.



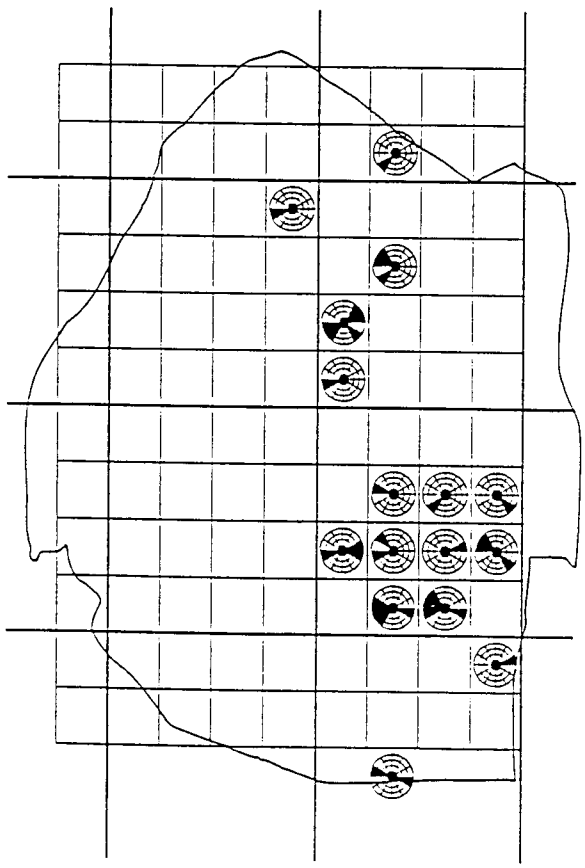
405. Fierynecked nightjar. (Caprimulgus pectoralis)

Recording frequency: 317 (/2263) 14%.
Population estimate: 1 000.
Status: Common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland and savanna.



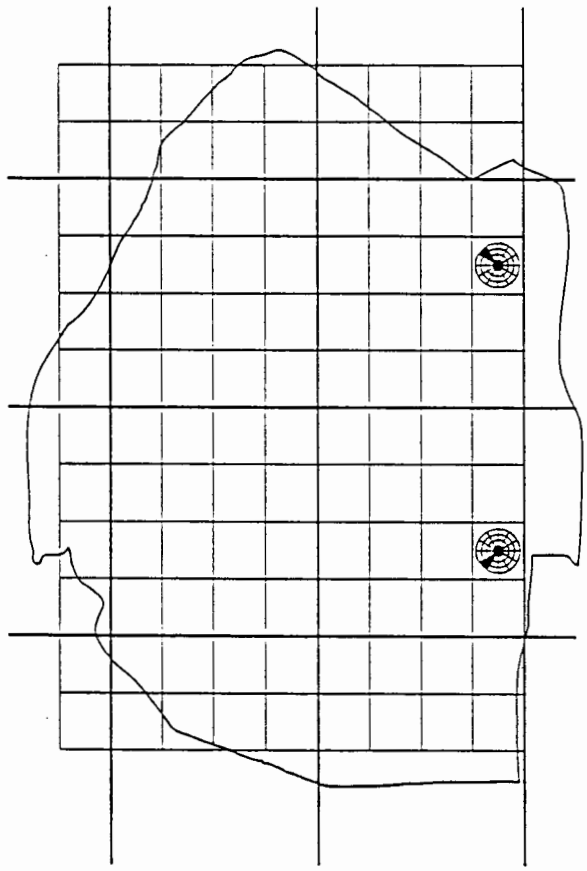
408. Freckled nightjar. (Caprimulgus tristigma)

Recording frequency: 19 (/2263) 1%.
Population estimate: 50.
Status: Uncommon breeding resident.
Habitat preference: Rocky outcrops.



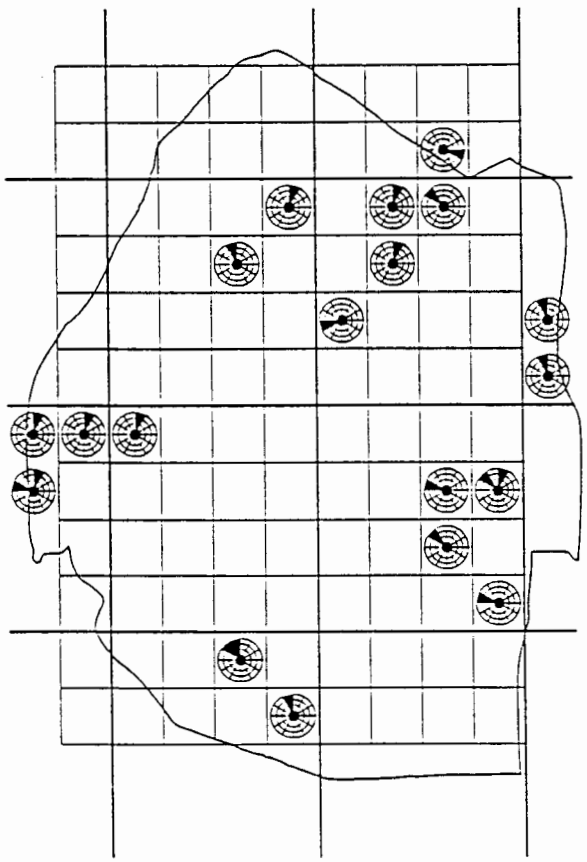
409. Mocambique nightjar. (Caprimulgus fossii)

Recording frequency: 36 (/2263) 2%.
Population estimate: 200.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Savanna.



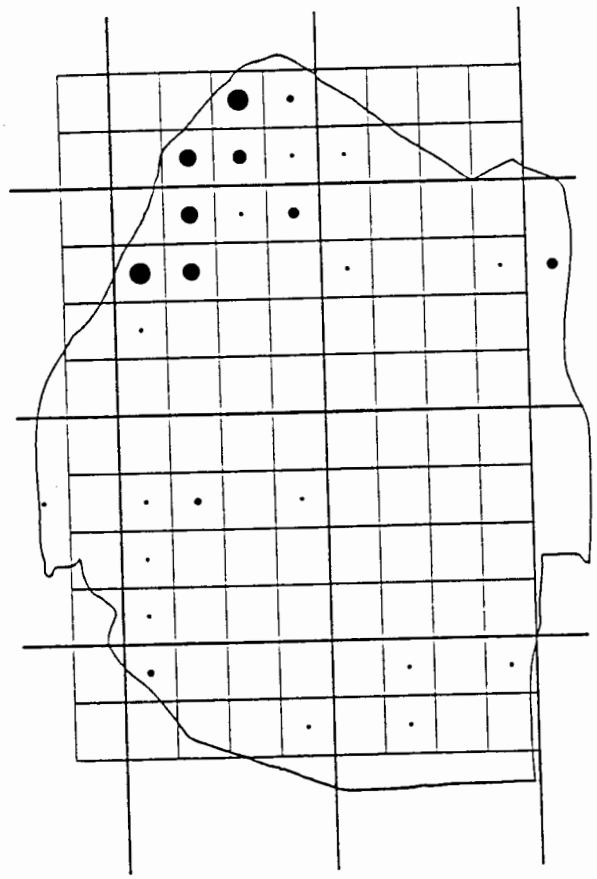
410. Pennantwinged nightjar. (Macrodipteryx vexillaria)

Recording frequency: 2 (/2263) 0,1 %.
Status: Vagrant in the lowveld.



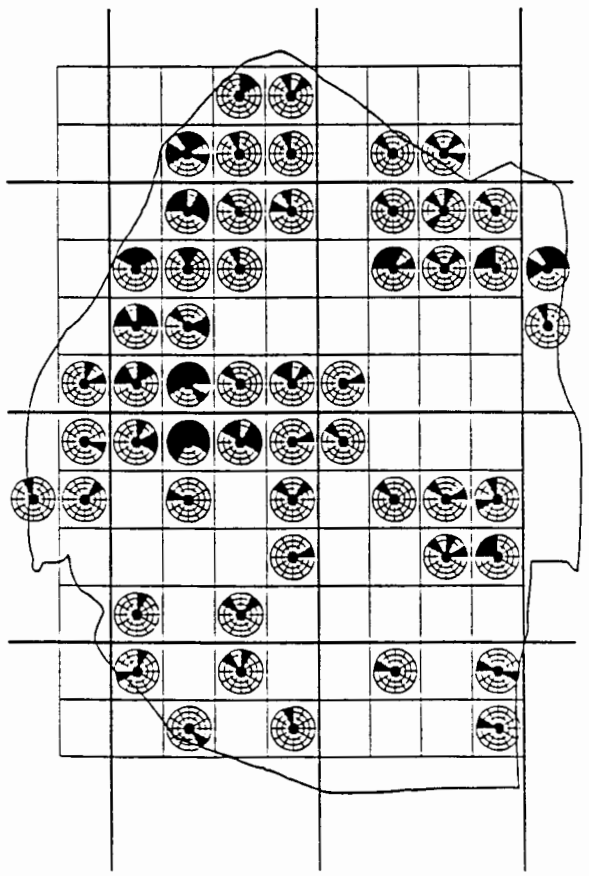
411. European swift. (Apus apus)

Recording frequency: 21 (/2263) 1%.
Status: Uncommon summer migrant. Possibly more common and widespread than indicated as its similarity to the black swift makes positive identification difficult. Sometimes encountered in flocks of 100 or more.
Habitat preference: Seen over all habitat types.



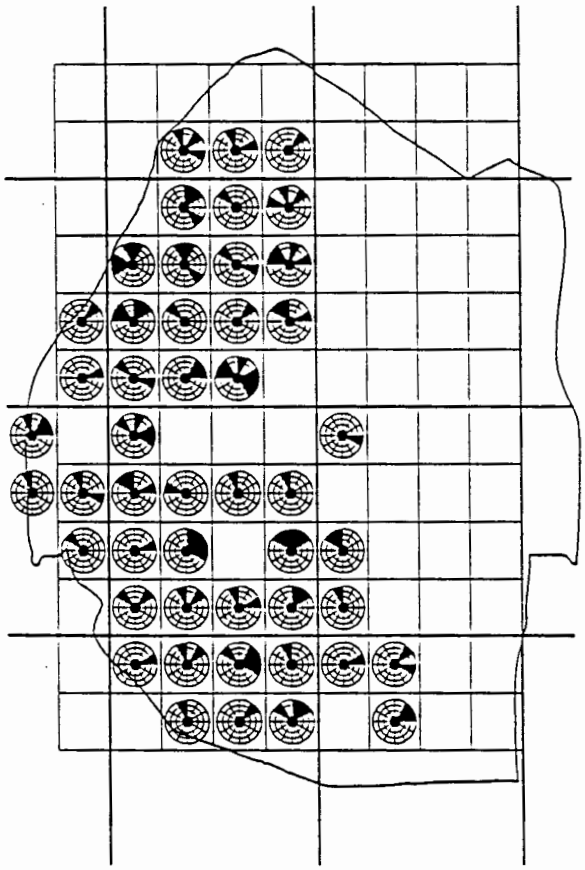
412. Black swift. (Apus barbatus)

Recording frequency: 62 (/2263) 3%.
Population estimate: 400.
Status: Uncommon breeding resident.
Habitat preference: Seen over all habitat types but usually near to the cliffs where it breeds.



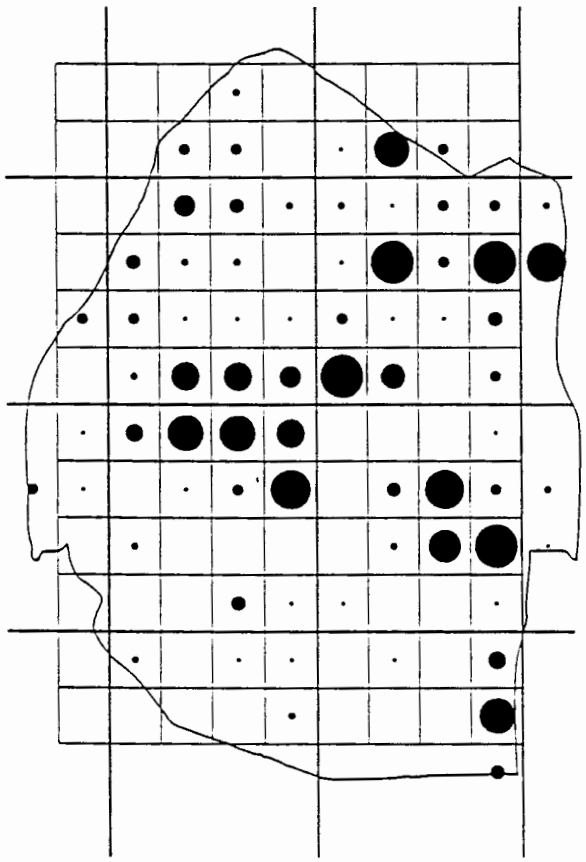
415. Whiterumped swift. (Apus caffer)

Recording frequency: 172 (/2263) 8%.
Population estimate: 1 000.
Status: Uncommon breeding summer migrant.
Habitat preference: Seen over all habitat types. Breeds on cliffs and buildings especially bridges.



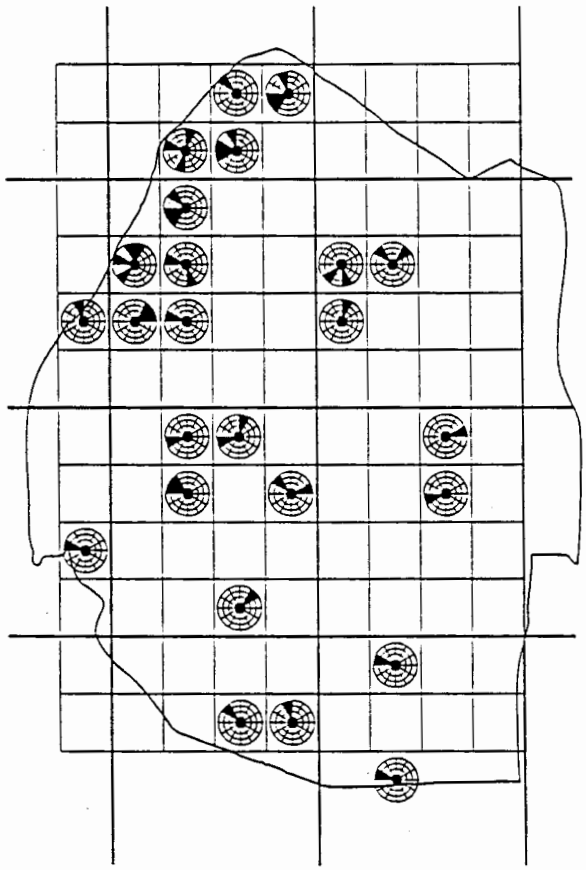
416. Horus swift. (Apus horus)

Recording frequency: 108 (/2263) 5%.
Population estimate: 1 000.
Status: Uncommon breeding summer migrant in the highveld and middleveld.
Habitat preference: Seen over all habitat types within its range. Breeds in sandbanks, dongas and road cuttings.



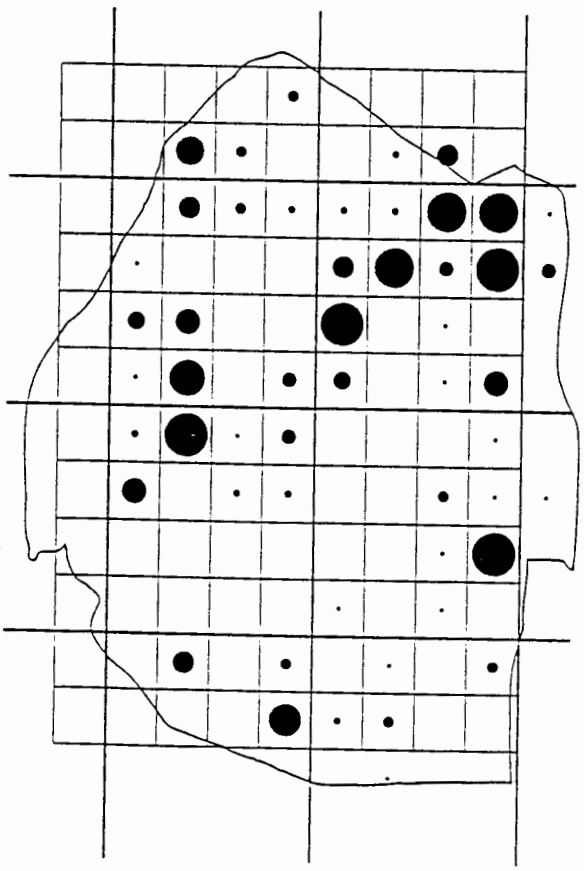
417. Little swift. (Apus affinus)

Recording frequency: 421 (/2263) 19%.
Population estimate: 5 000.
Status: Common breeding resident.
Habitat preference: Seen over all habitat types. Breeds mostly on road bridges, but also other buildings and cliffs.



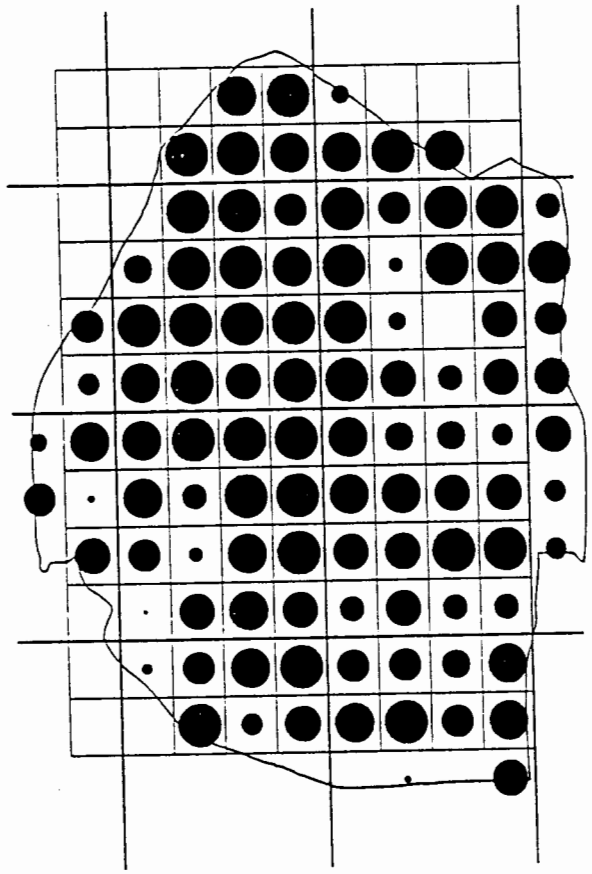
418. Alpine swift. (Apus melba)

Recording frequency: 41 (/2263) 2%.
Status: It is not clear whether the species is an uncommon visitor or breeding resident.
Habitat preference: Seen over all habitat types.

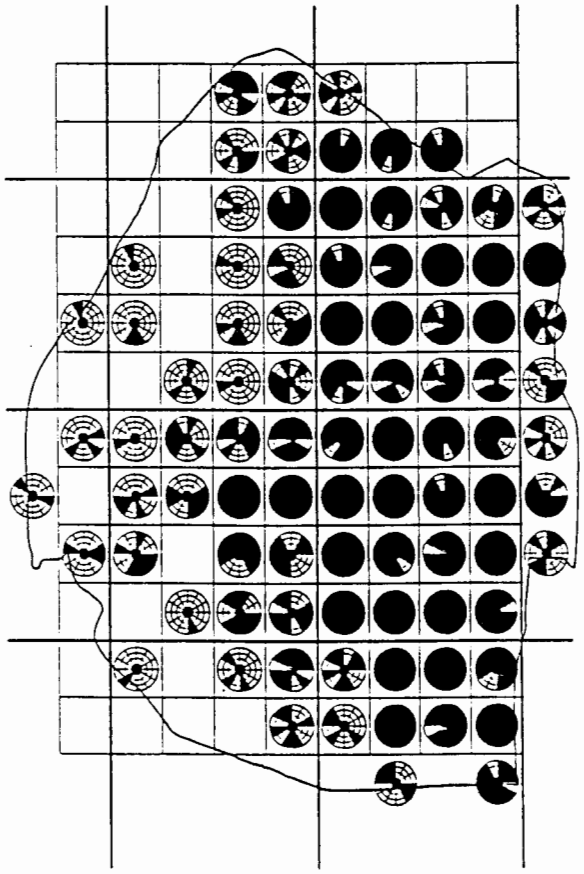


421. Palm swift. (Cypsiurus parvus)

Recording frequency: 372 (/2263) 16%.
Population estimate: 1 000.
Status: Common breeding resident.
Habitat preference: Seen over all habitat types. Usually breeds in large exotic palm trees but has also been observed breeding on a building in Simunye (D10).

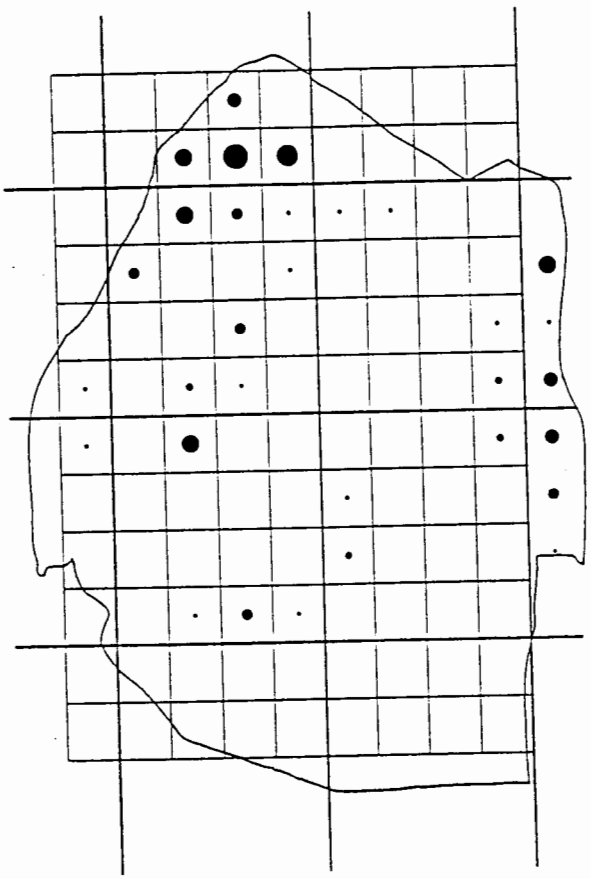


424. Speckled mousebird. (Colius striatus)
Recording frequency: 1 527(/2263) 67%.
Population estimate: 40 000.
Status: Very common breeding resident.
Habitat preference: Forest and woodland but is absent from the dichrostachys-scrub woodland at Hlane (E9).



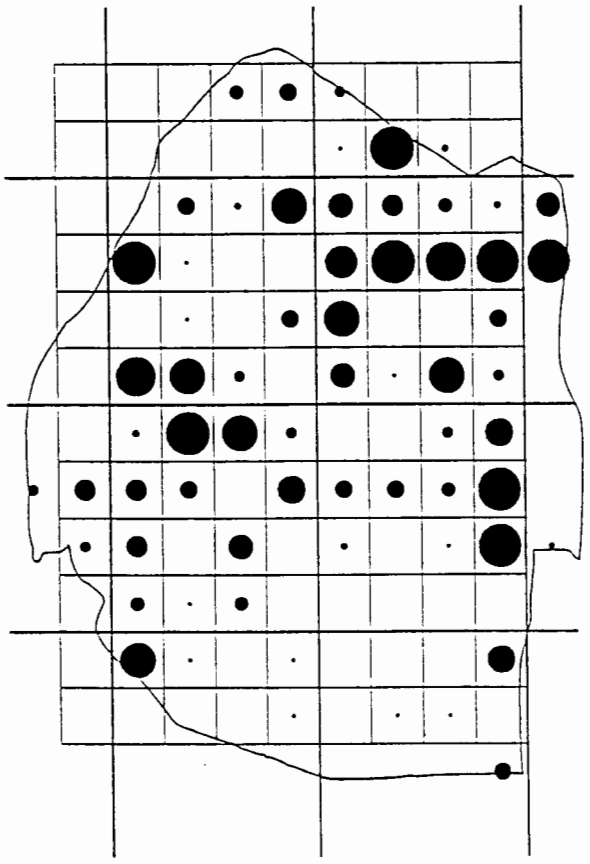
426. Redfaced mousebird. (Colius indicus)

Recording frequency: 903 (/2263) 40%.
Population estimate: 20 000.
Status: Common breeding resident in the lowveld and Lubombos and uncommon visitor (mostly in winter) to the middleveld and highveld.
Habitat preference: Woodland and savanna.



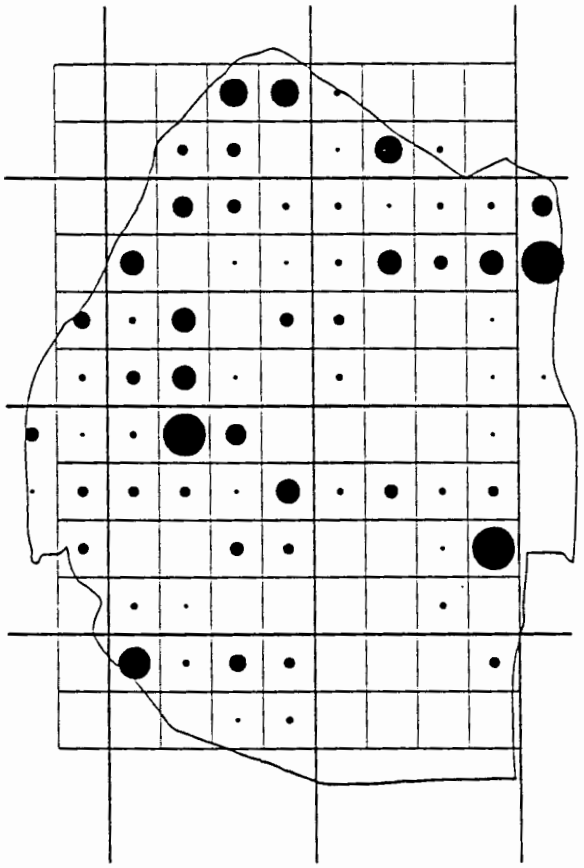
427. Narina trogon. (Apaloderma narina)

Recording frequency: 93 (/2263) 4%.
Population estimate: 400.
Status: Uncommon breeding resident.
Habitat preference: Forest and woodland.



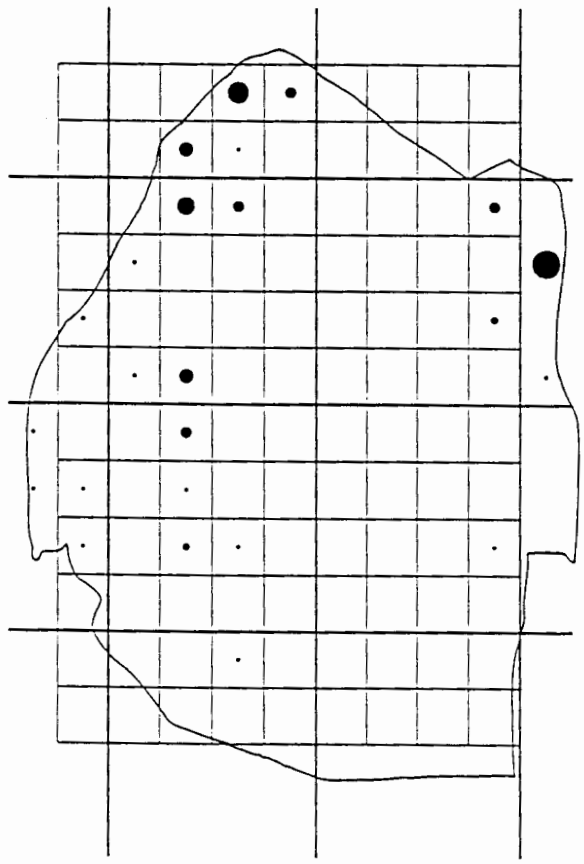
428. Pied kingfisher. (Ceryle rudis)

Recording frequency: 597 (/2263) 26%.
Population estimate: 2 000.
Status: Common breeding resident. The species did not occur in the Umbuluzi gorge (D11) prior to cyclone Demoina in February 1984 (J. Culverwell, pers. comm.). Floods in the wake of the cyclone stripped the forests from the river banks and created a habitat more suitable to this species and it is now common there. As most river courses in the lowveld were similarly affected by the floods, the species has probably increased significantly throughout the lowveld.
Habitat preference: Dams and rivers with open banks.



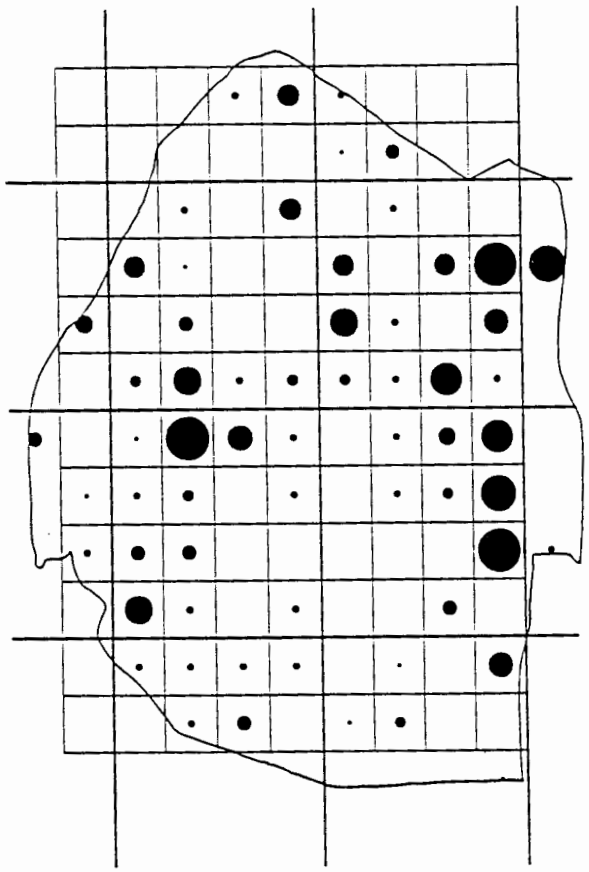
429. Giant kingfisher. (Ceryle maxima)

Recording frequency: 385 (/2263) 17%.
Population estimate: 1 000.
Status: Uncommon breeding resident.
Habitat preference: Dams and rivers.



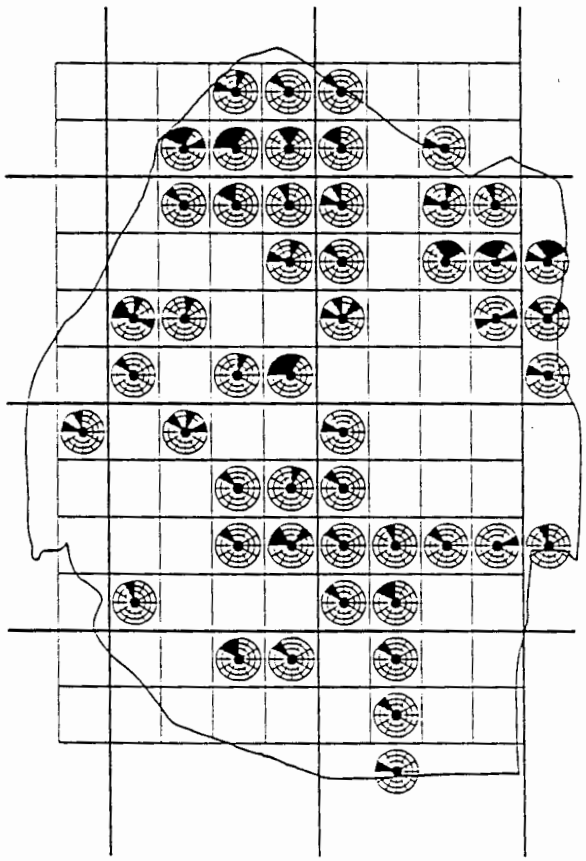
430. Halfcollared kingfisher. (Alcedo semitorquata)

Recording frequency: 65 (/2263) 3%.
Population estimate: 300.
Status: Uncommon breeding resident in the highveld, middleveld and Lubombos.
Habitat preference: Quiet streams with well wooded banks.



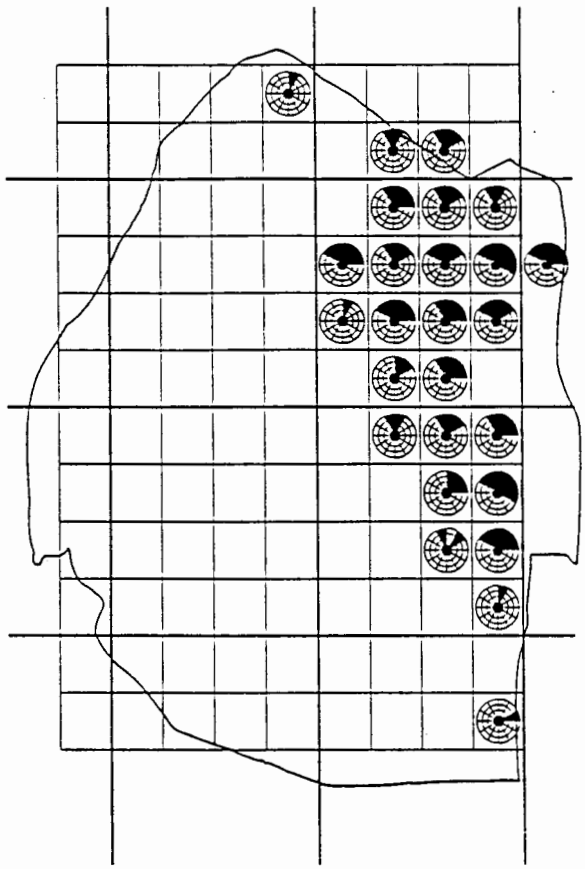
431. Malachite kingfisher. (Alcedo cristata)

Recording frequency: 373 (/2263) 16%.
Population estimate: 1 000.
Status: Common breeding resident.
Habitat preference: Dams, rivers and vleis.



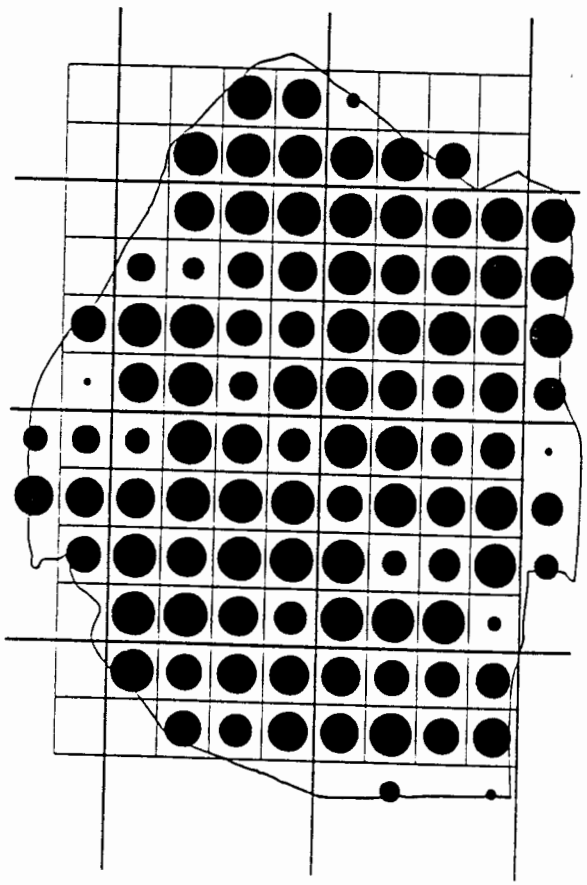
432. Pygmy kingfisher. (Ispidina picta)

Recording frequency 101 (/2263) 4%.
Population estimate: 1 000.
Status: Uncommon breeding summer migrant.
Habitat preference: Woodland.



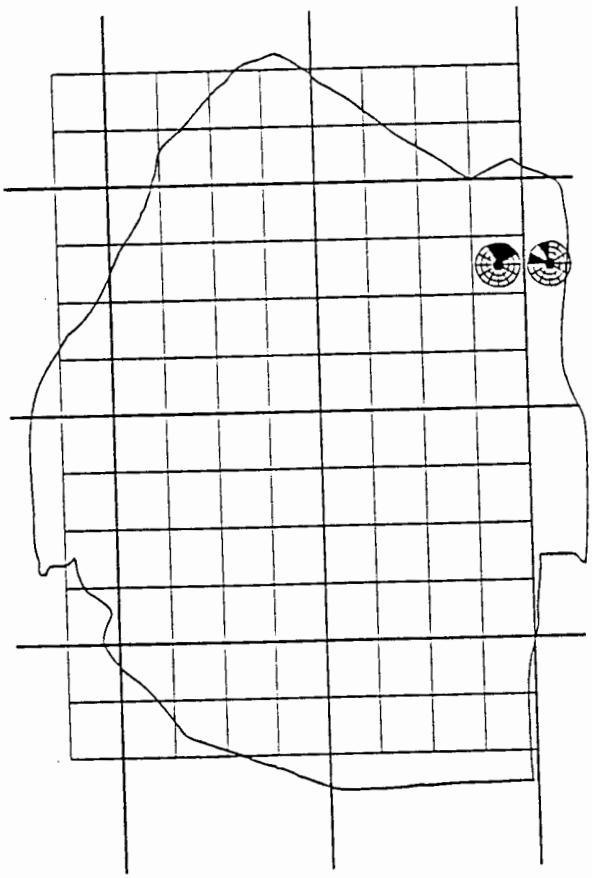
433. Woodland kingfisher. (Halcyon senegalensis)

Recording frequency: 144 (/2263) 6%.
Population estimate: 400.
Status: Uncommon breeding summer migrant in the northern lowveld.
Habitat preference: Woodland and savanna.



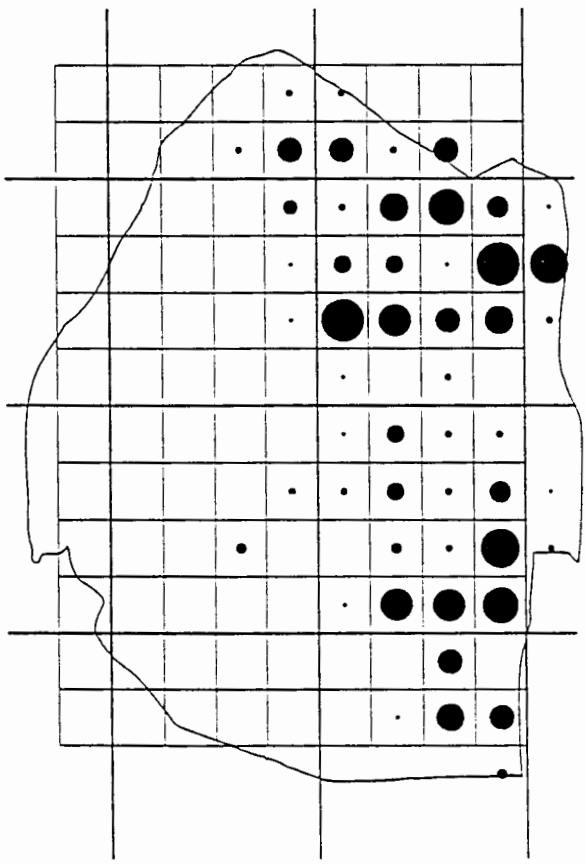
435. Brownhooded kingfisher. (Halcyon albiventris)

Recording frequency: 1 626 (/2263) 72%.
Population estimate: 20 000.
Status: Very common breeding resident.
Habitat preference: Woodland and savanna.



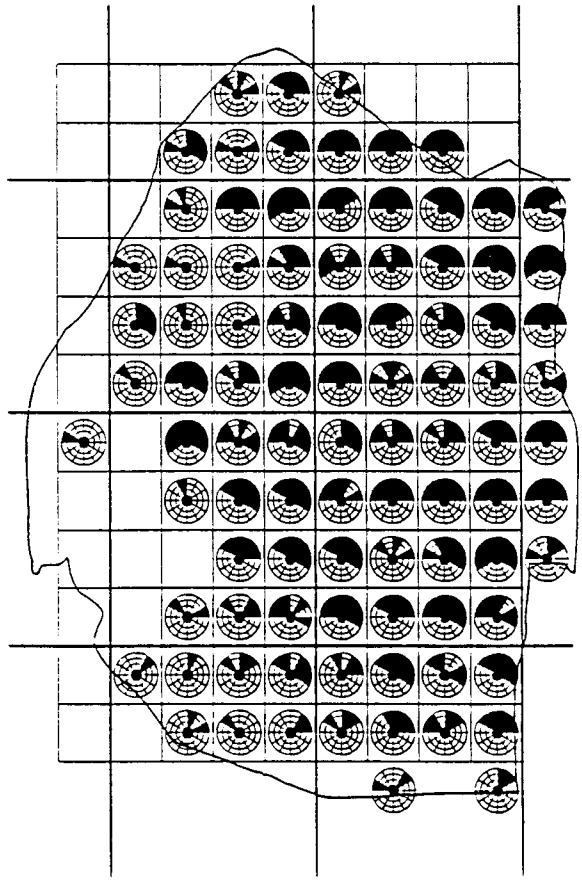
436. Greyhooded kingfisher. (Halcyon leucocephala)

Recording frequency: 6 (/2263) 0,25%.
Status: Rare summer migrant, possibly breeding. Recorded only in the Mlawula nature reserve (D10, D11) (J. Culverwell)
Habitat preference: Woodland and savanna.



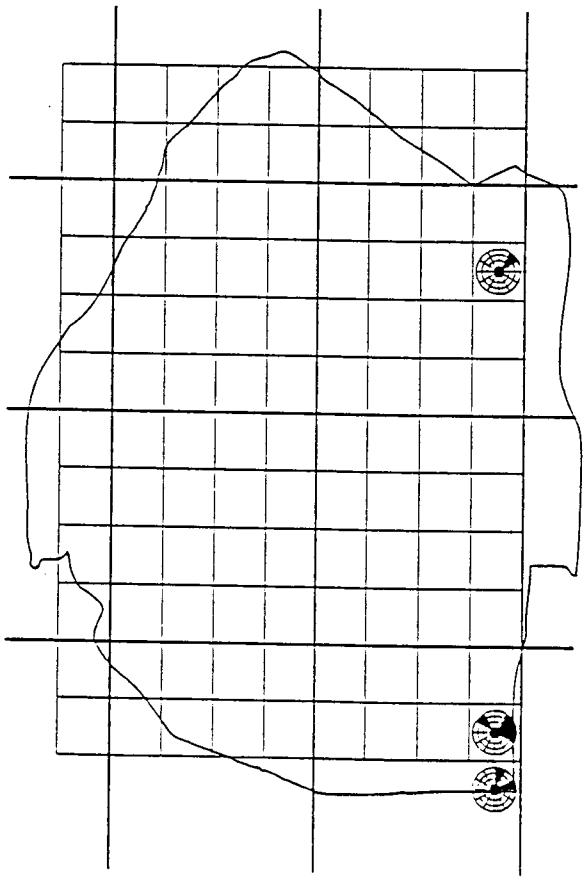
437. Striped kingfisher. (Halcyon chelicuti)

Recording frequency: 302 (/2263) 13%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the middleveld and lowveld.
Habitat preference: Woodland and savanna.



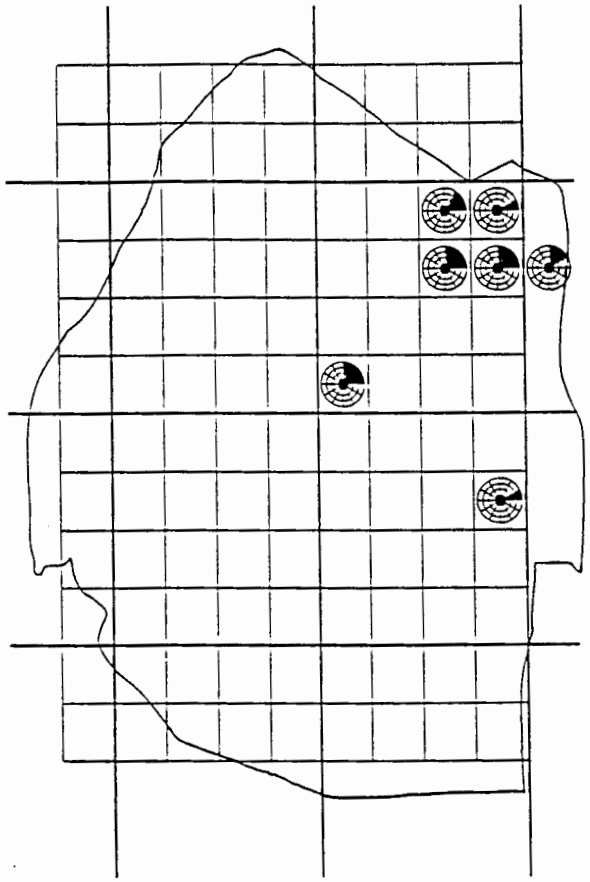
438. European bee-eater. (Merops apiaster)

Recording frequency: 615 (/2263) 27%.
Status: Very common summer migrant in the middleveld, lowveld and Lubombos but rare in the highveld.
Habitat preference: Woodland and savanna.



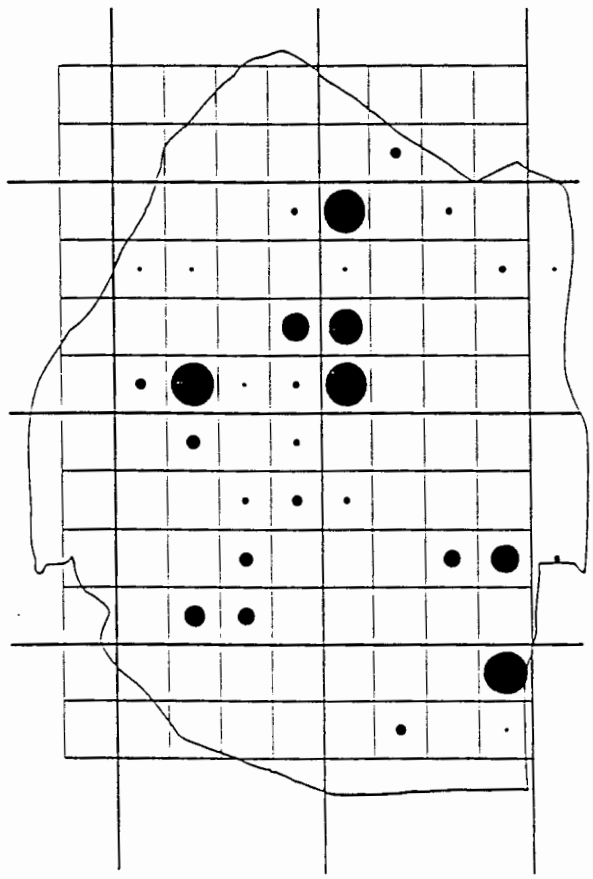
440. Bluecheeked bee-eater. (Merops persicus)

Recording frequency: 7 (/2263) 0,35%.
Status: Uncommon summer migrant in the lowveld, seen regularly near Lavumisa (L10, M10) in the south and only once in the north (D10).



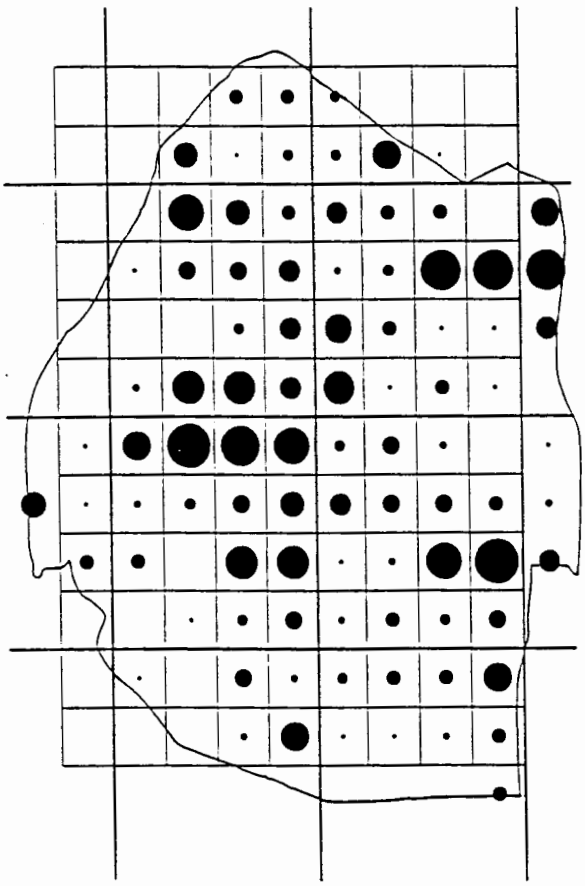
441. Carmine bee-eater. (Merops nubicoides)

Recording frequency: 20 (/2263) 1%.
Status: Uncommon late summer migrant in the northern lowveld, present from the end of December to April.
Habitat preference: Savanna.



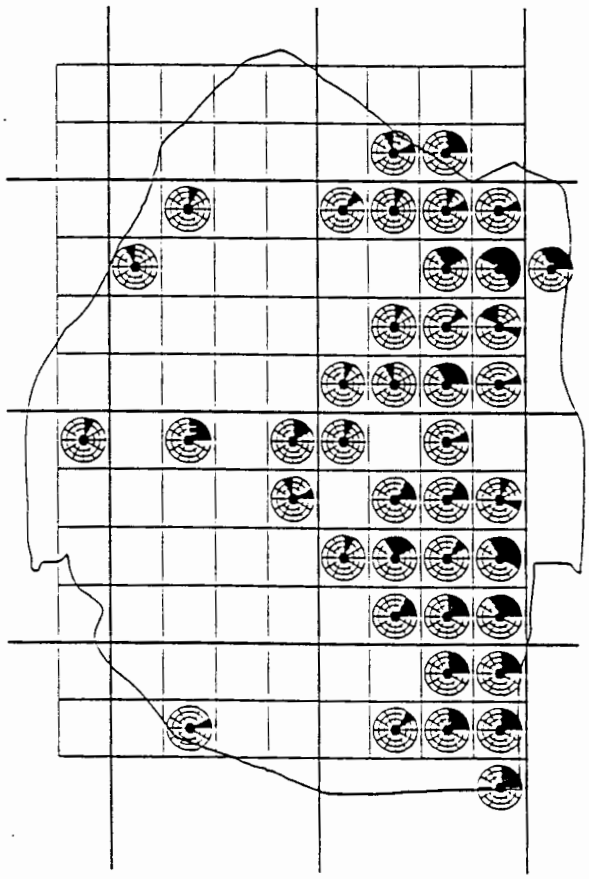
443. Whitefronted bee-eater. (Merops bullockoides)

Recording frequency: 173 (/2263) 8%.
Population estimate: 600.
Status: Uncommon breeding resident.
Habitat preference: Woodland and savanna. Particularly attracted to stands of exotic eucalypt trees in the middleveld. Breeds in riverbanks and dongas. Is most common where tall stands of eucalypt trees occur together with large dongas.



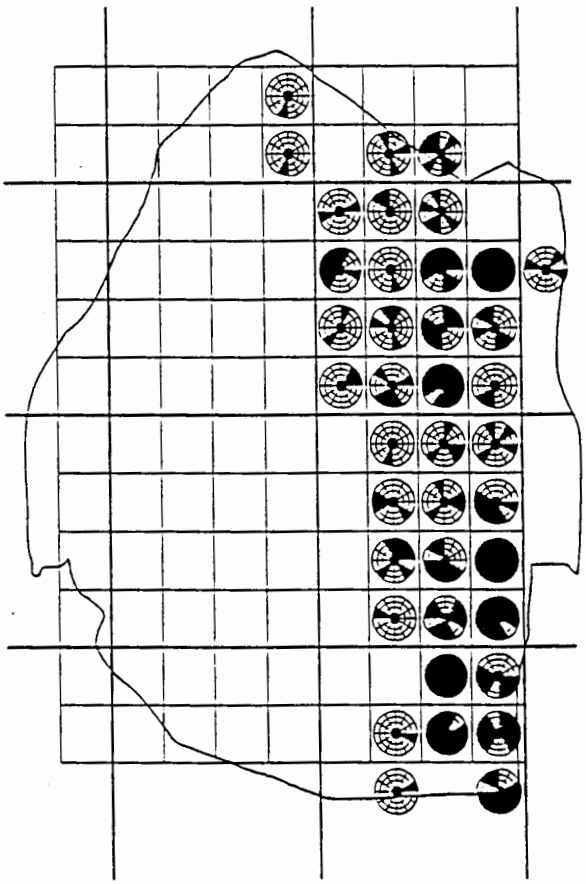
444. Little bee-eater. (Merops pusillus)

Recording frequency: 526 (/2263) 23%.
Population estimate: 1 000.
Status: Uncommon breeding resident.
Habitat preference: Savanna.



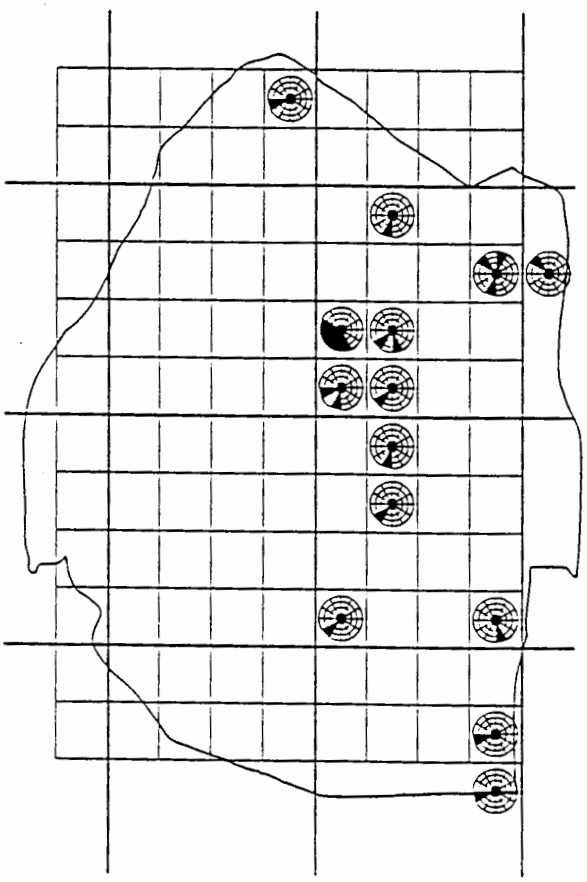
446. European roller. (Coracias garrulus)

Recording frequency: 109 (/2263) 5%.
Status: Uncommon summer migrant in the lowveld and vagrant in the middleveld and highveld.
Habitat preference: Savanna and cultivated lands. Often seen at the roadside.



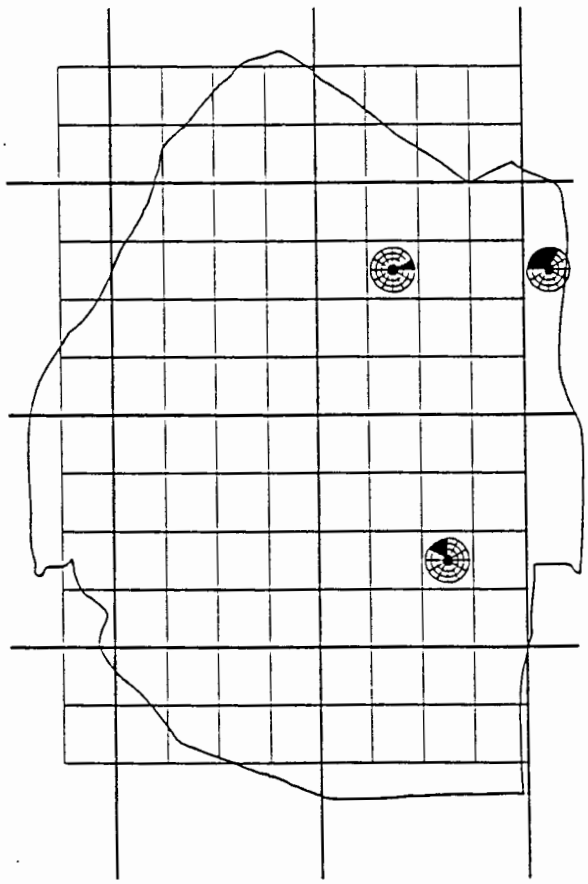
447. Lilacbreasted roller. (Coracias caudata)

Recording frequency: 328 (/2263) 14%.
Population estimate: 700.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Savanna. Usually seen at the roadside.
During the winter of 1992 a single bird was present for some weeks among pine plantations near Piggs Peak (B5).



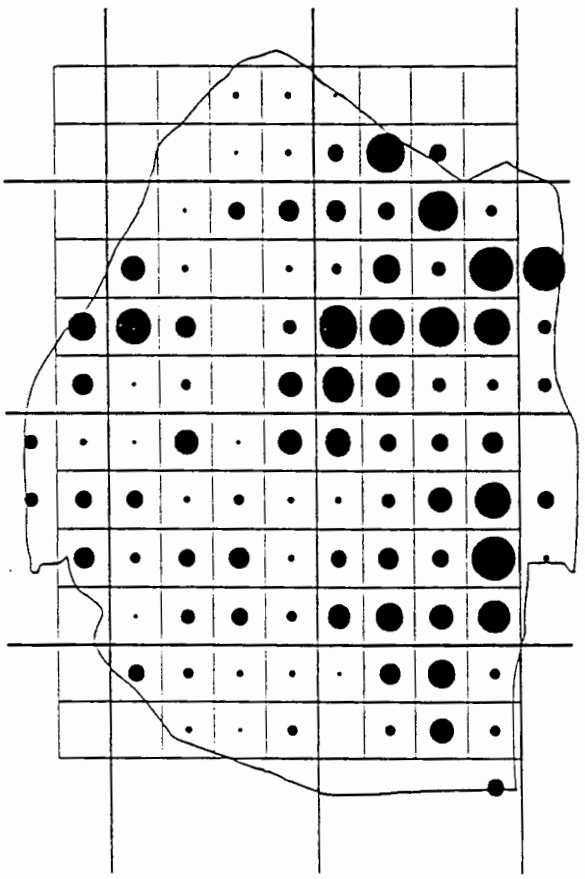
449. Purple roller. (Coracias naevia)

Recording frequency: 20 (/2263) 1%.
Status: Uncommon visitor in the lowveld, mostly in winter.
Habitat preference: Woodland and savanna.

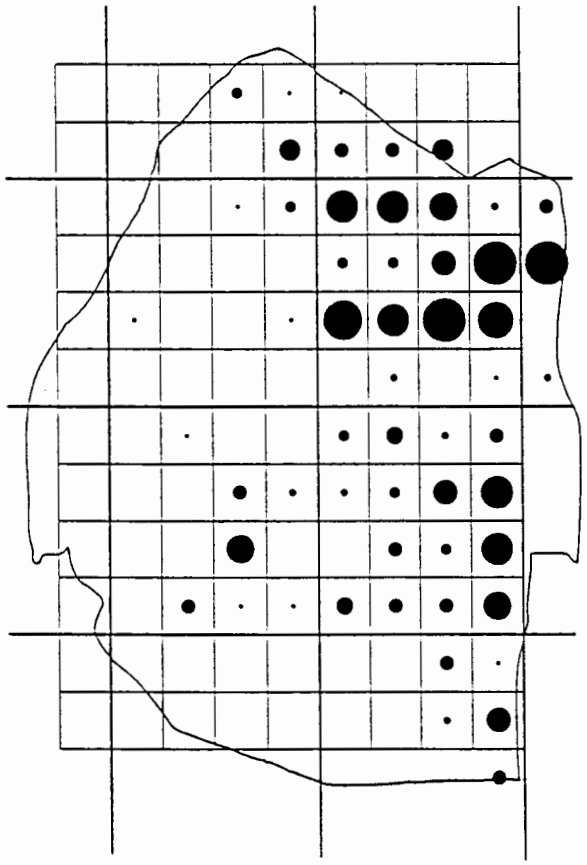


450. Broadbilled roller. (Eurystomus glaucurus)

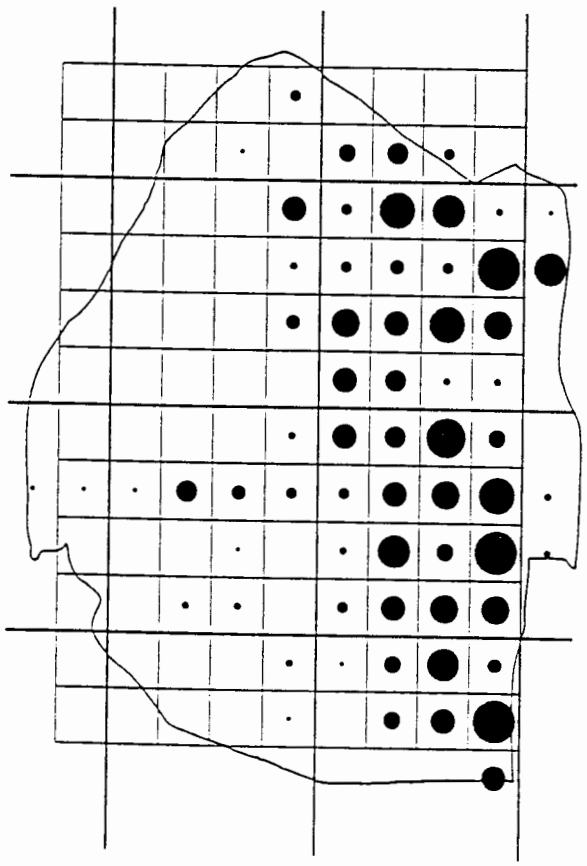
Recording frequency: 7 (/2263) 0,35%.
Population estimate: 10.
Status: Rare summer migrant in the lowveld, recorded breeding in the Umbuluzi Gorge (D11).
Habitat preference: Riverine woodland.



451. Hoopoe. (Upupa epops)
Recording frequency: 670 (/2263) 30%.
Population estimate: 10 000.
Status: Common breeding resident.
Habitat preference: Savanna and grassland.

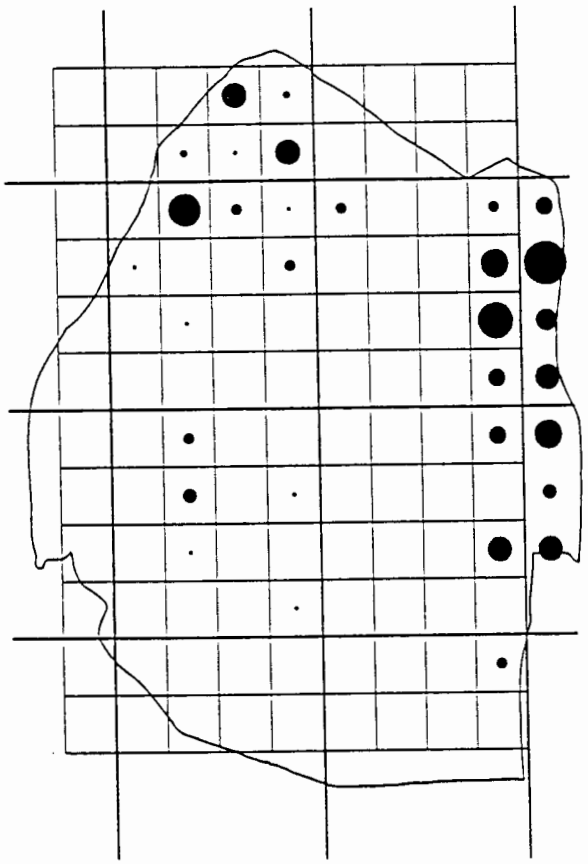


452. Redbilled woodhoopoe. (Phoeniculus purpureus)
Recording frequency: 340 (/2263) 15%.
Population estimate: 5 000.
Status: Common breeding resident in the lowveld, uncommon in the Lubombos and middleveld and vagrant in the highveld.
Habitat preference: Woodland and savanna.



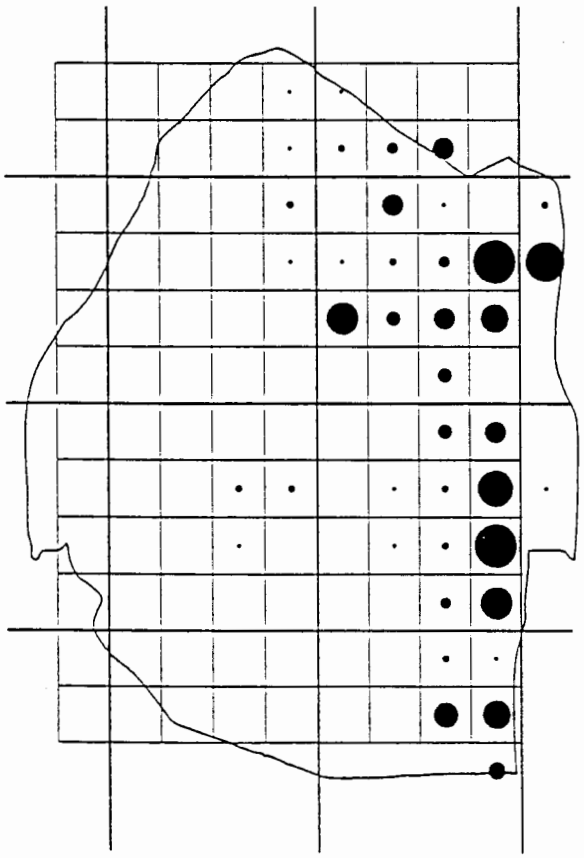
454. Scimitarbilled woodhoopoe. (Phoeniculus cyanomelas)

Recording frequency: 393 (/2263) 17%.
Population estimate: 8 000.
Status: Common breeding resident in the lowveld, uncommon in the Lubombos and middleveld and intruding along the Usutu river into the highveld.
Habitat preference: Woodland and savanna.



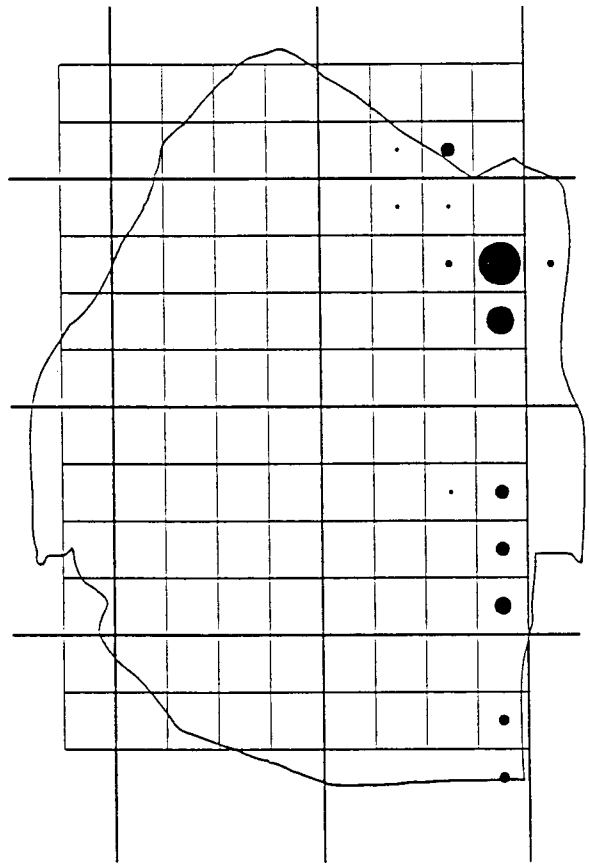
455. Trumpeter hornbill. (Bycanistes bucinator)

Recording frequency: 184 (/2263) 8%.
Population estimate: 200.
Status: Uncommon breeding resident in the middleveld, eastern lowveld and Lubombos.
Habitat preference: Forest and woodland.



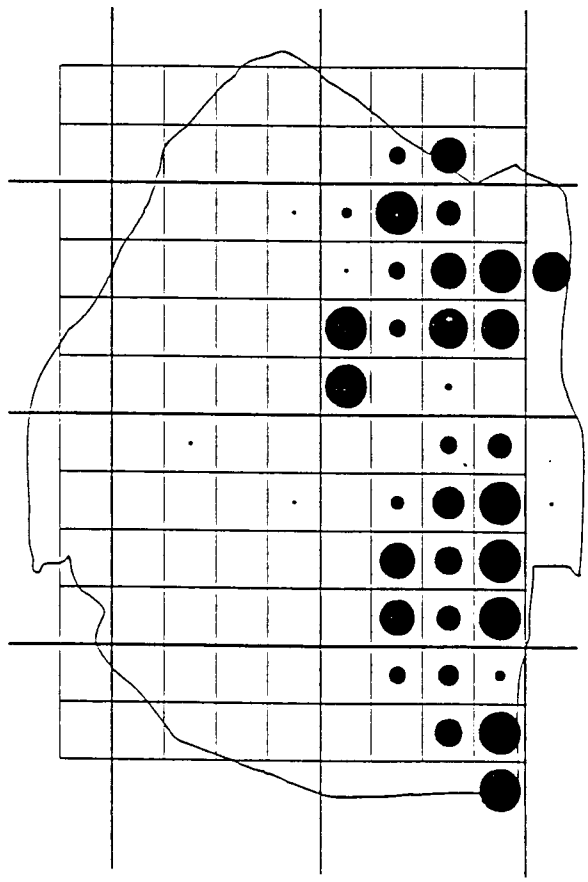
457. Grey hornbill. (Tockus nasutus)

Recording frequency: 240 (/2263) 11%.
Population estimate: 400.
Status: Uncommon breeding resident in the lowveld and Lubombos.
Habitat preference: Woodland and savanna.



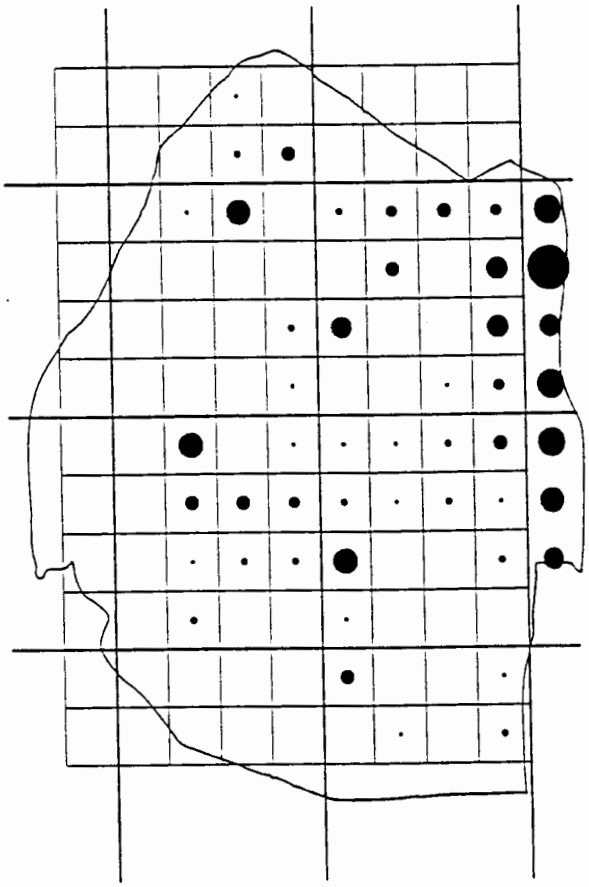
458. Redbilled hornbill. (Tockus erythrorhynchus)

Recording frequency: 79 (/2263) 3%.
Population estimate: 150.
Status: Uncommon breeding resident in the eastern lowveld.
Habitat preference: Knobthorn-marula savanna.



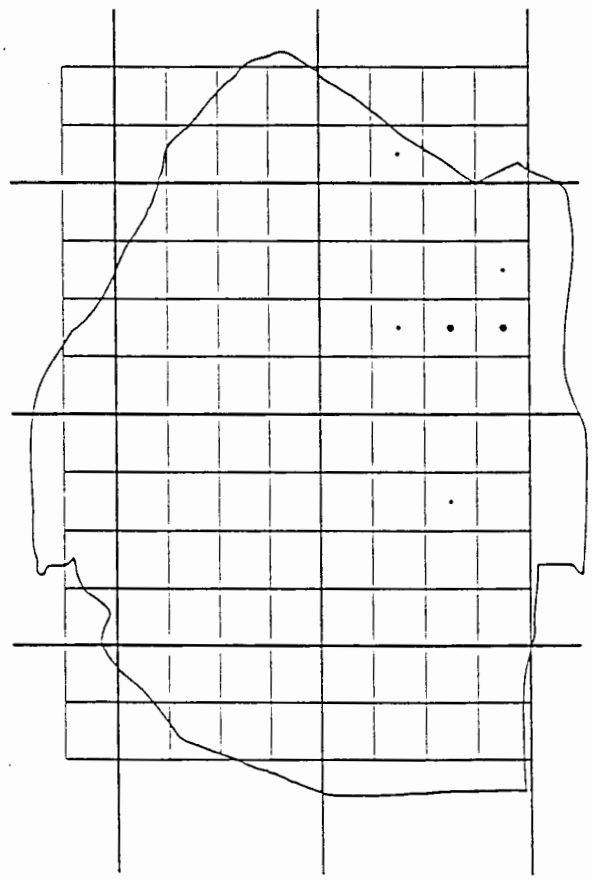
459. Yellowbilled hornbill. (Tockus flavirostris)

Recording frequency: 440 (/2263) 19%.
Population estimate: 2 000.
Status: Common breeding resident in the lowveld.
Habitat preference: Thorn savanna.

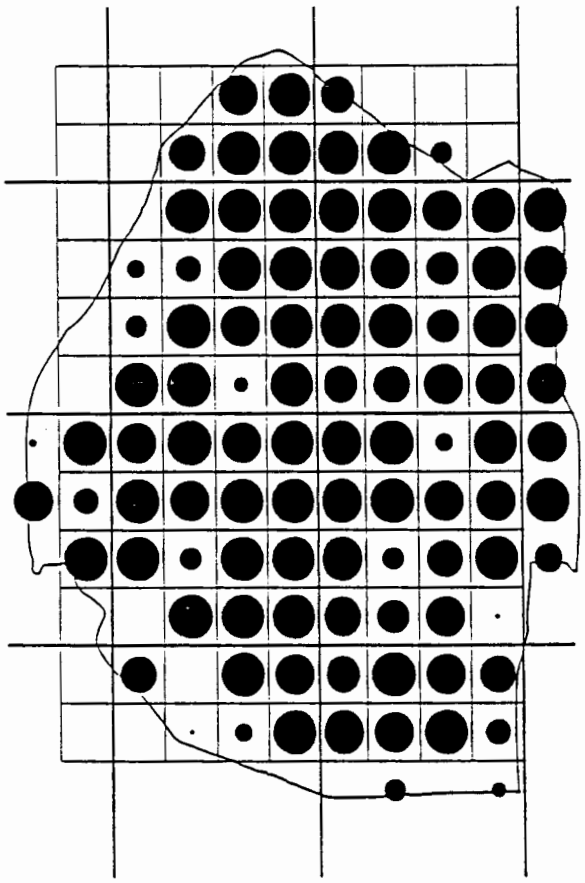


460. Crowned hornbill. (Tockus alboterminatus)

Recording frequency: 193 (/2263) 9%.
Population estimate: 200.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Forest and woodland.

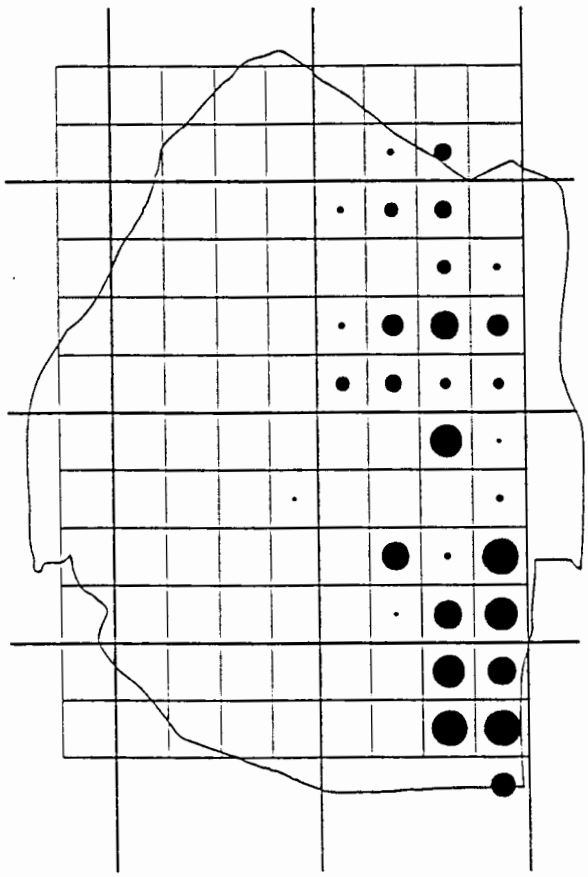


463. Ground hornbill. (Bucorvus leadbeateri)
Recording frequency: 7 (/2263) 0,3%.
Population estimate: 4.
Status: Rare breeding resident in the lowveld. Probably only 2 or 3 family groups survive, ranging through Hlane and neighbouring areas. They have possibly been adversely affected by the extensive bush encroachment that has occurred in Hlane.
Habitat preference: Woodland and savanna.



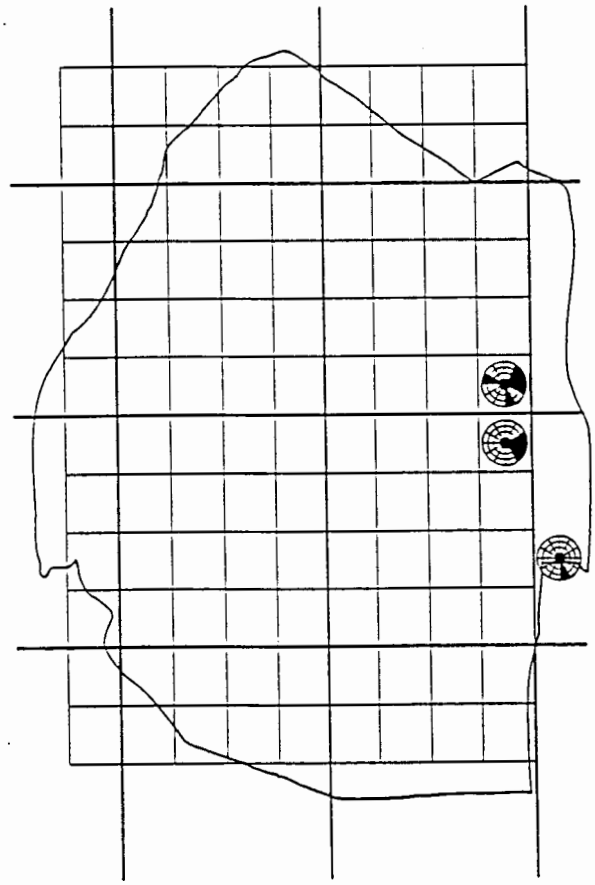
464. Blackcollared barbet. (Lybius torquatus)

Recording frequency: 1 464 (/2263) 65%.
Population estimate: 40 000.
Status: Very common breeding resident in most regions but does not occur above 1200 m altitude in the highveld and is uncommon in less heavily wooded parts of the lowveld where it is sympatric with the pied barbet.
Habitat preference: Woodland and savanna.



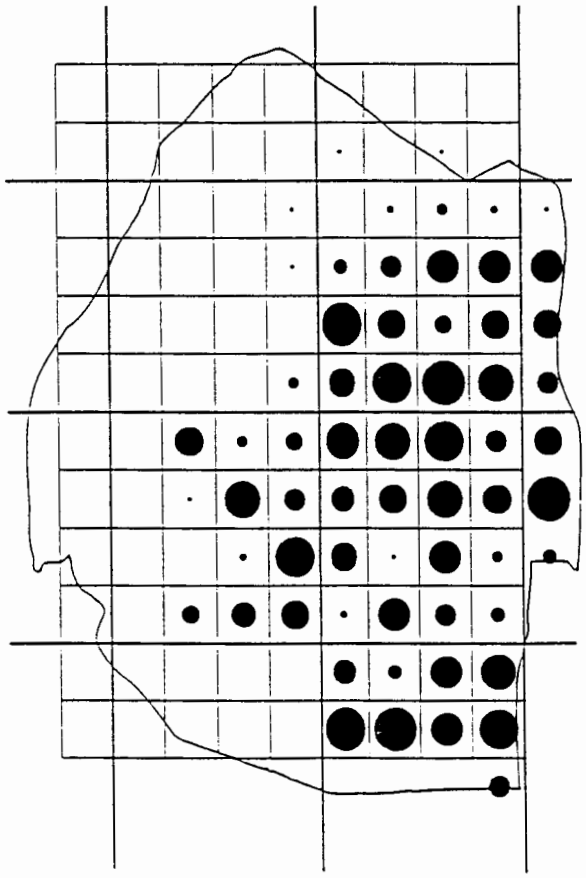
465. Pied barbet. (Lybius leucomelas)

Recording frequency: 165 (/2263) 7%.
Population estimate: 3 000.
Status: Uncommon breeding resident in the lowveld. Commonest in the less densely wooded parts of the lowveld.
Habitat preference: Thorn savanna.



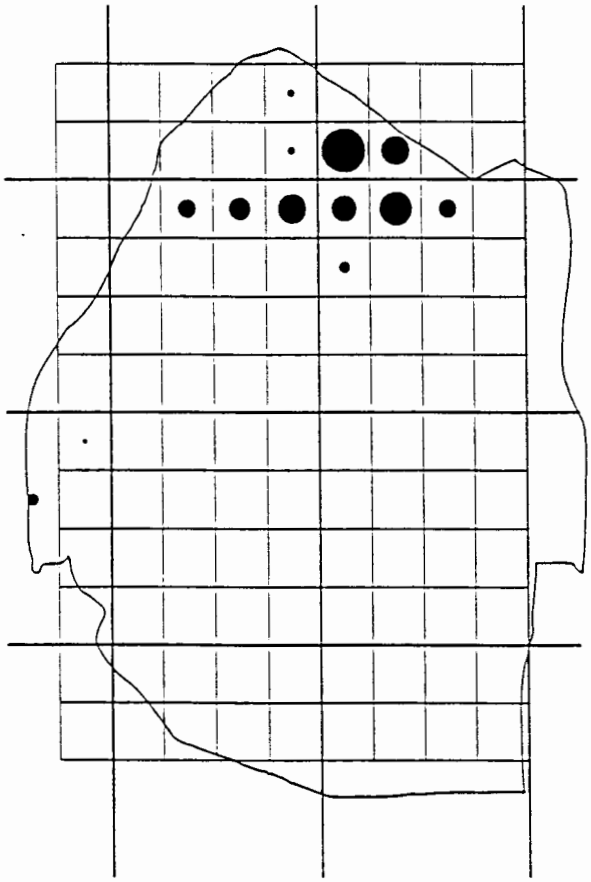
466. White-eared barbet. (Stactolaema leucotis)

Recording frequency: 9 (/2263) 0,45%.
Status: Uncommon visitor in the Lubombos.
Habitat preference: Woodland and forest.



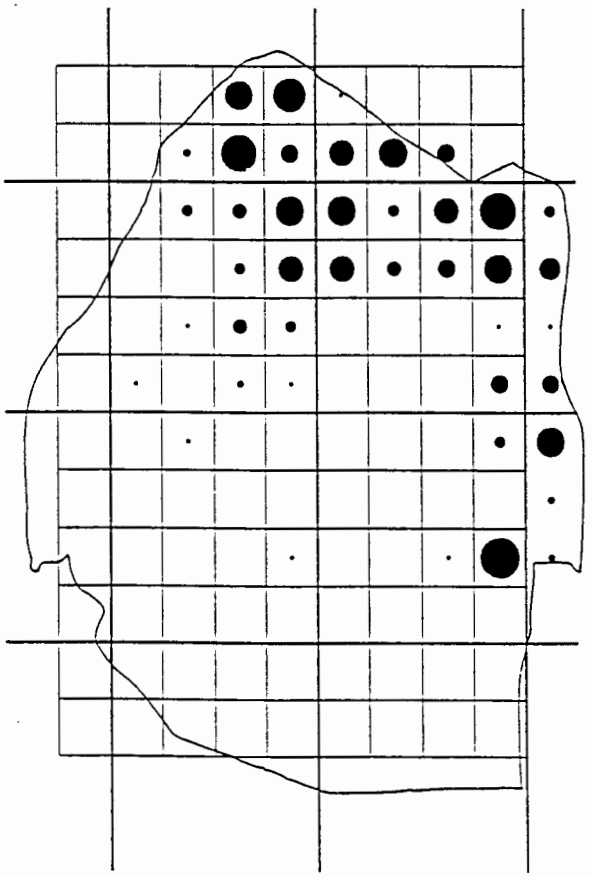
469. Redfronted tinker barbet. (Pogoniulus pusillus)

Recording frequency: 463 (/2263) 20%.
Population estimate: 10 000.
Status: Common breeding resident in the lowveld and Lubombos. Its distribution meets but does not overlap with that of the next species.
Habitat preference: Woodland.



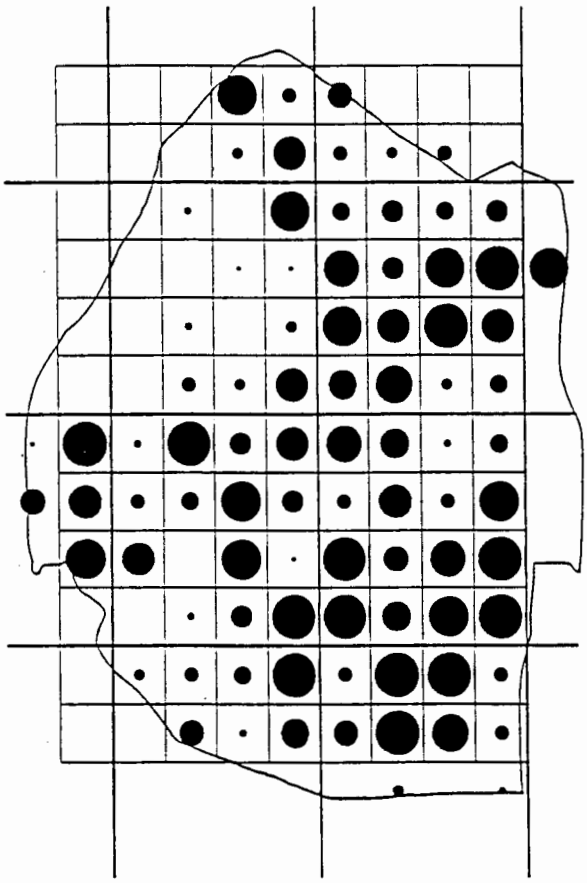
470. Yellowfronted tinker barbet. (Pogoniulus chrysoconus)

Recording frequency: 76 (/2263) 3%.
Population estimate: 2 000.
Status: Uncommon breeding resident in the northern middleveld and northern lowveld and in the Usutu valley in the west of the highveld. Does not overlap with the previous species although their distributions meet along a line corresponding closely with the division between granitic and basalt based soils.
Habitat preference: Woodland.



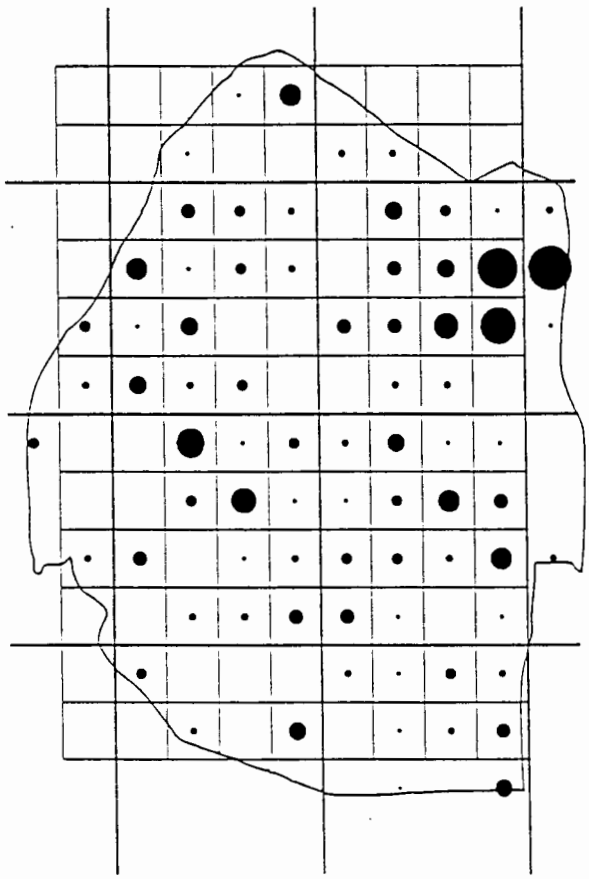
471. Goldenrumped tinker barbet. (Pogoniulus bilineatus)

Recording frequency: 225 (/2263) 10%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the northern middleveld, north western and eastern lowveld and Lubombos.
Habitat preference: Mature woodland and forest. Occurs alongside both of the previous two species.



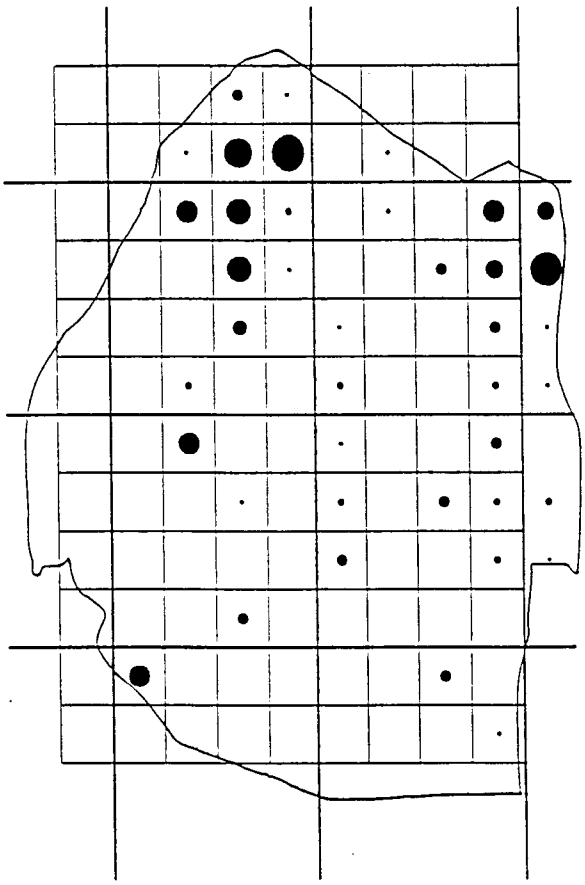
473. Crested barbet. (Trachyphonus vaillantii)

Recording frequency: 777 (/2263) 34%.
Population estimate: 8 000.
Status: A common breeding resident in most regions but is absent from the northern highveld and Lubombos.
Habitat preference: Woodland and savanna.



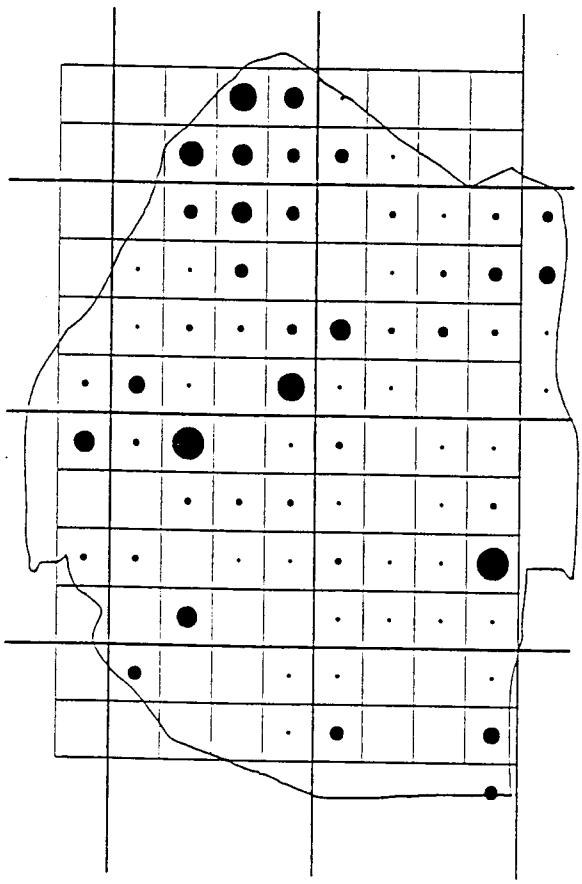
474. Greater honeyguide. (Indicator indicator)

Recording frequency: 298(/2263) 13%.
Population estimate: 3 000.
Status: Uncommon breeding resident.
Habitat preference: Wattle stands in the highveld, woodland and savanna elsewhere.



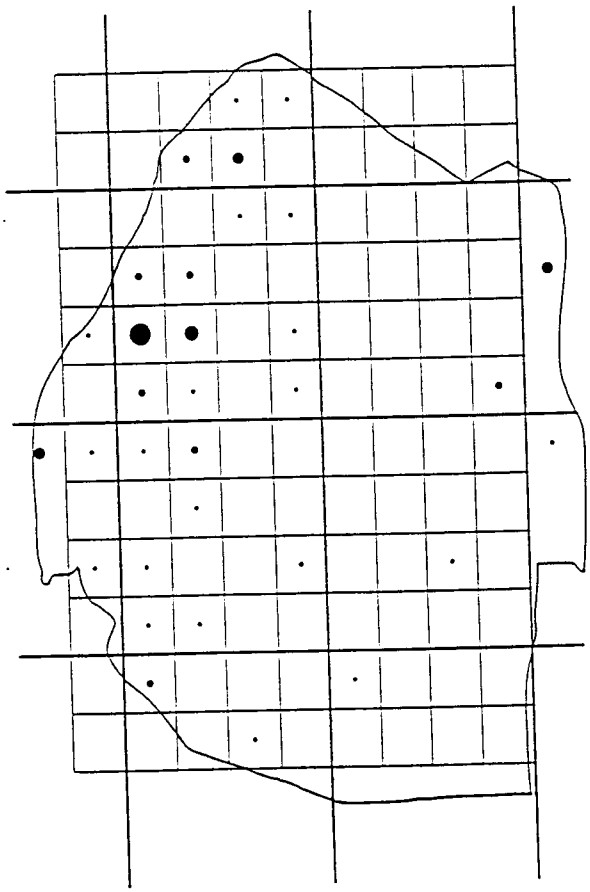
475. Scalythroated honeyguide. (Indicator variegatus)

Recording frequency: 152 (/2263) 7%.
Population estimate: 800.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Forest and woodland and occasionally savanna.



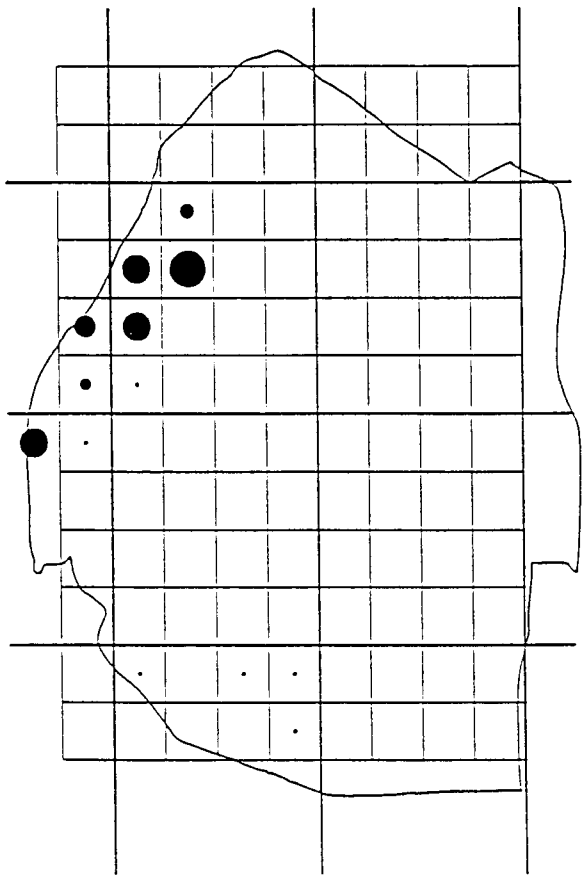
476. Lesser honeyguide. (Indicator minor)

Recording frequency: 213 (/2263) 9%.
Population estimate: 2 000.
Status: Uncommon breeding resident.
Habitat preference: Woodland and savanna.



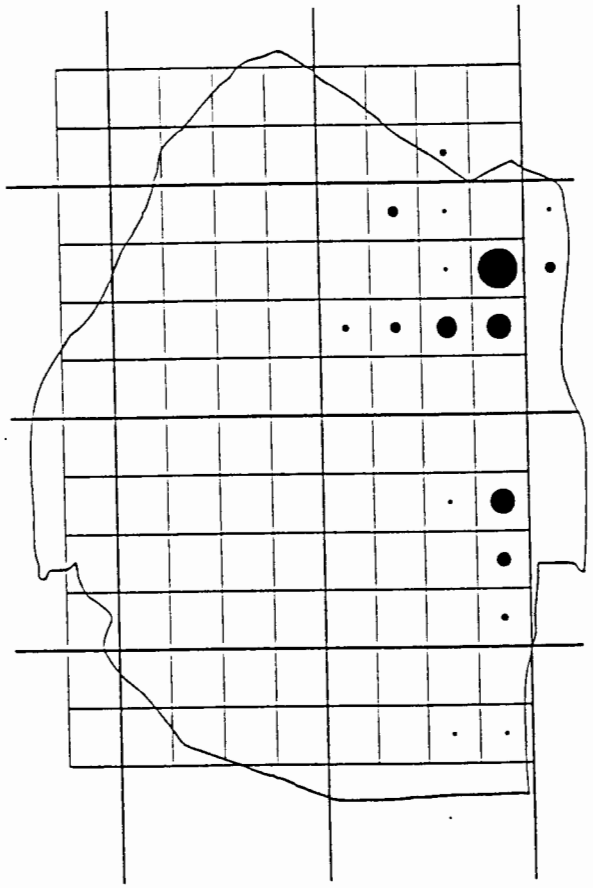
478. Sharpbilled honeyguide. (Prodotiscus regulus)

Recording frequency: 56 (/2263) 2%.
Population estimate: 300.
Status: A breeding resident, uncommon in the highveld and rare elsewhere.
Habitat preference: Forest and woodland.



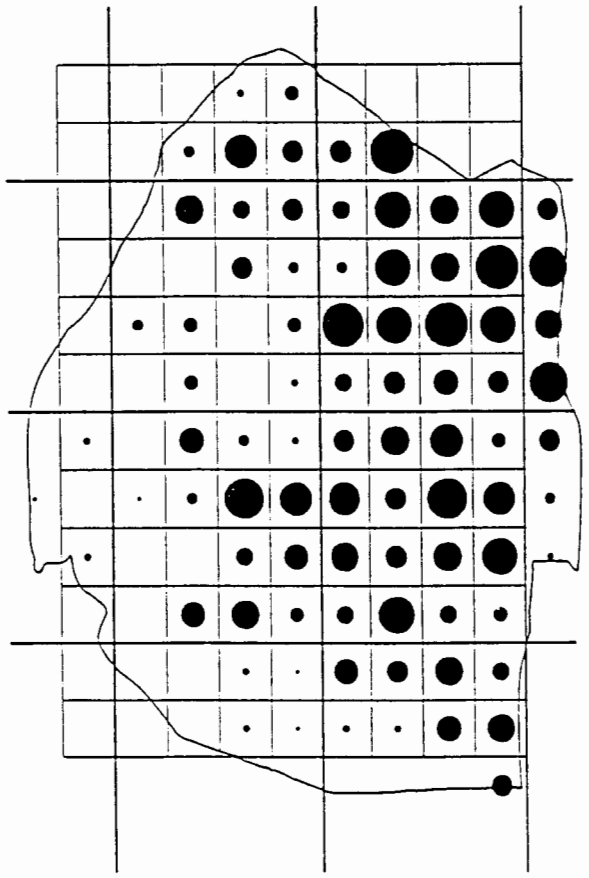
480. Ground woodpecker. (Geocolaptes olivaceus)

Recording frequency: 59 (/2263) 3%.
Population estimate: 300.
Status: Uncommon breeding resident in the highveld.
Habitat preference: Found among rocky outcrops in highveld grassland.



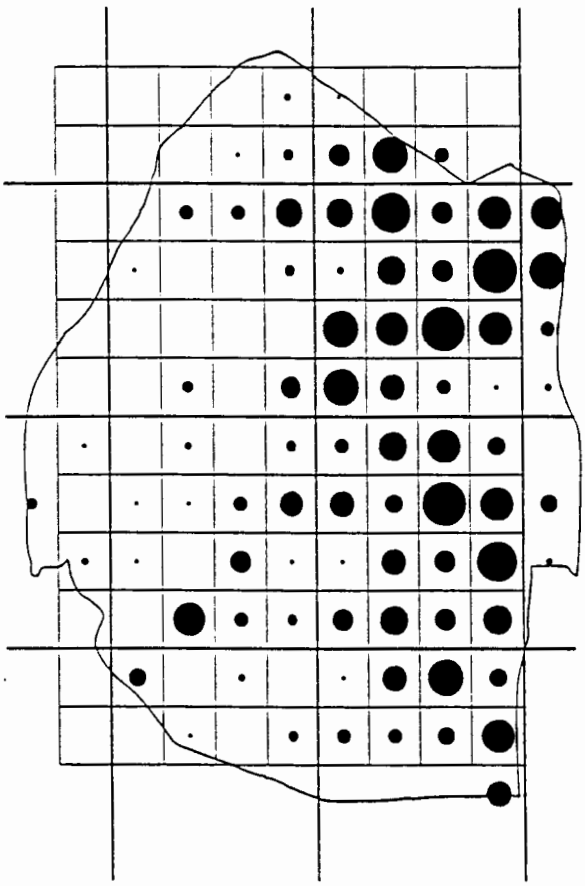
481. Bennett's woodpecker. (Campethera bennettii)

Recording frequency: 67 (/2263) 3%.
Population estimate: 200.
Status: Uncommon breeding resident.
Habitat preference: Thorn savanna.



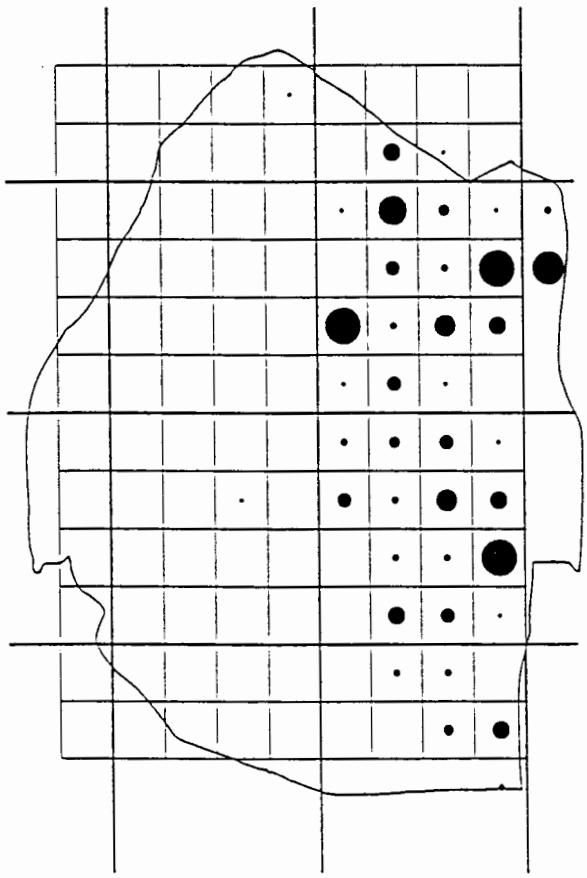
483. Goldentailed woodpecker. (Campethera abingoni)

Recording frequency: 604 (/2263) 27%.
Population estimate: 8 000.
Status: Common breeding resident.
Habitat preference: Forest, woodland and savanna.



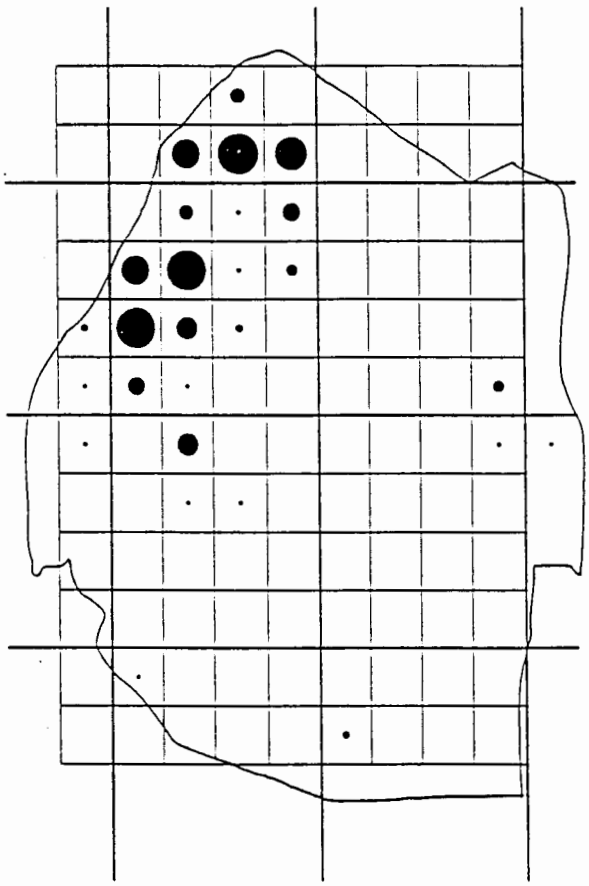
486. Cardinal woodpecker. (Dendropicus fuscescens)

Recording frequency: 494 (/2263) 22%.
Population estimate: 10 000.
Status: Common breeding resident in most regions but absent from the northern highveld.
Habitat preference: Woodland and savanna.



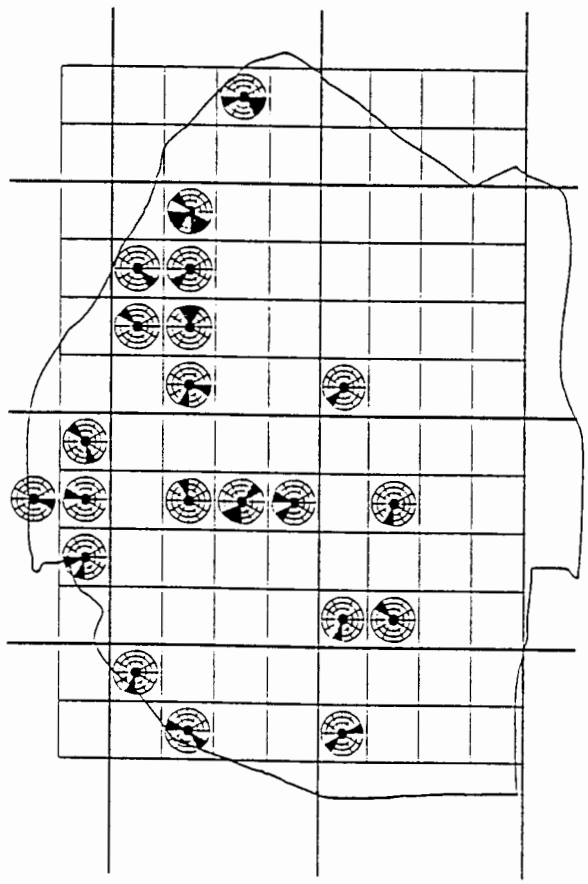
487. Bearded woodpecker. (Thripias namaquus)

Recording frequency: 176 (/2263) 8%.
Population estimate: 2 000.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Acacia woodland and savanna.



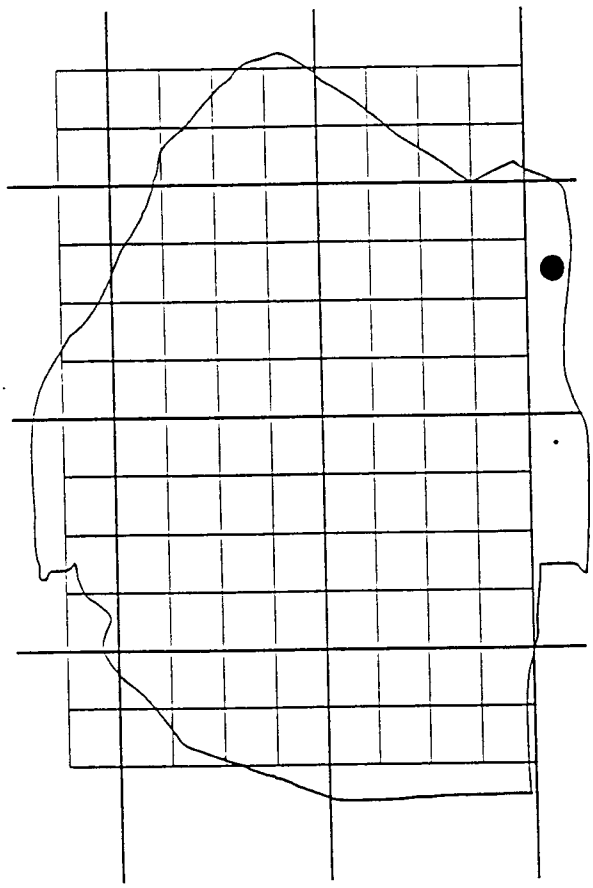
488. Olive woodpecker. (Mesopicos griseocephalus)

Recording frequency: 136 (/2263) 6%.
Population estimate: 1 000.
Status: A breeding resident in the highveld and middleveld, common in the north and rare in the south and uncommon on the highest part of the Lubombos.
Habitat preference: Forest.



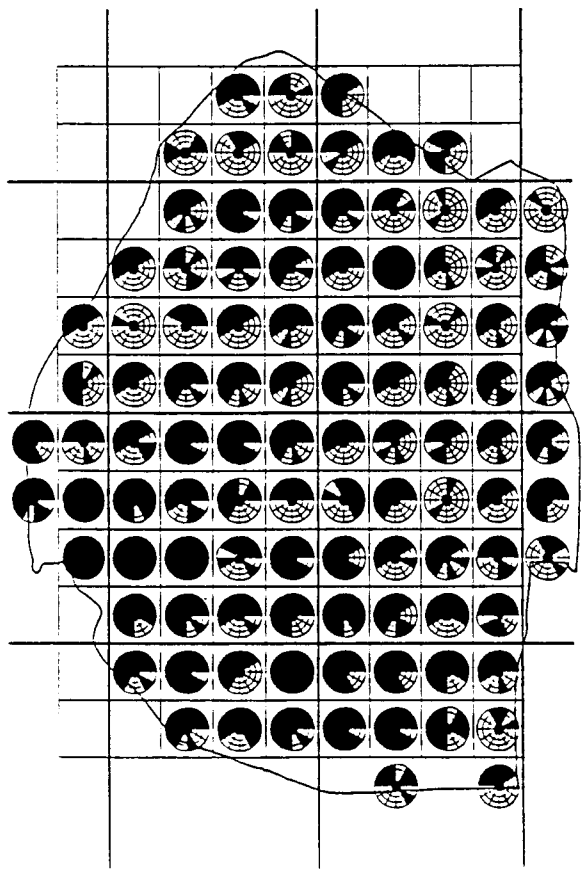
489. Redthroated wryneck. (Jynx ruficollis)

Recording frequency: 33 (/2263) 1%.
Population estimate: 100.
Status: Uncommon breeding resident in the highveld, middleveld and western lowveld.
Habitat preference: Woodland/grassland mosaic.



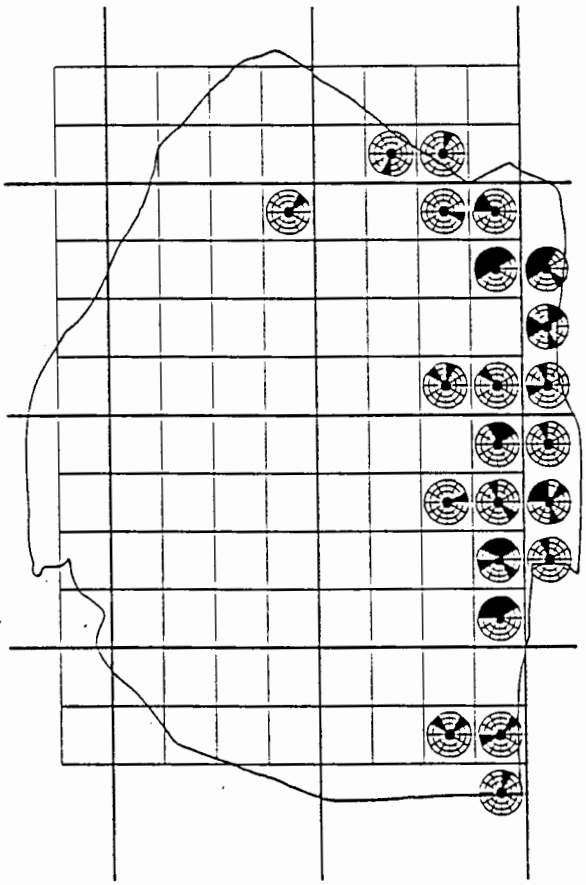
490. African broadbill. (Smithornis capensis)

Recording frequency: 9 (/2263) 0,45%.
Population estimate: 50.
Status: Rare breeding resident in the Lubombos.
Habitat preference: Occurs only in the larger forests.



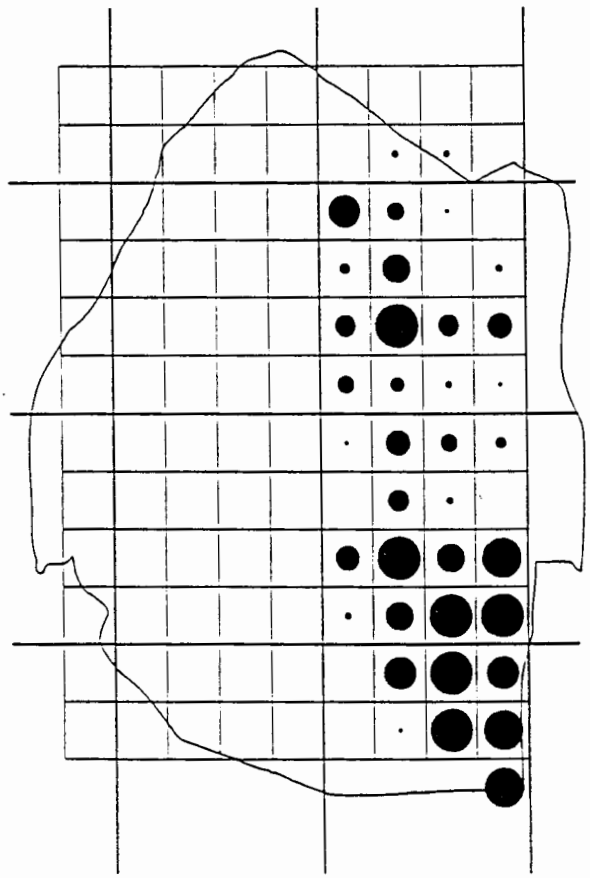
494. Rufousnaped lark. (Mirafra africana)

Recording frequency: 898 (/2263) 40%.
Population estimate: 100 000.
Status: Very common breeding resident.
Habitat preference: Grassland, savanna and cultivated lands.



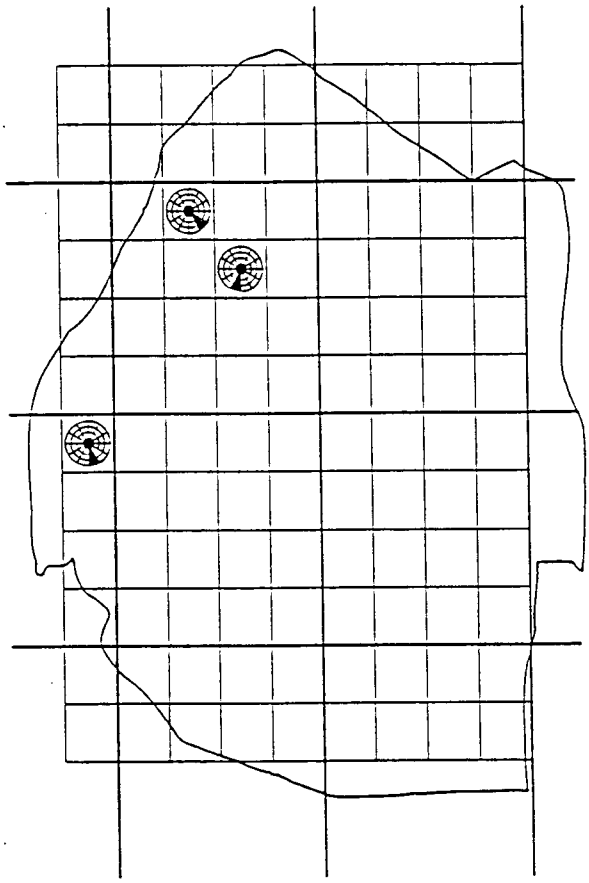
496. Flappet lark. (Mirafra rufocinnamomea)

Recording frequency: 64 (/2263) 3%.
Population estimate: 400.
Status: A breeding resident, uncommon in the Lubombos and rare in the lowveld.
Habitat preference: Savanna.



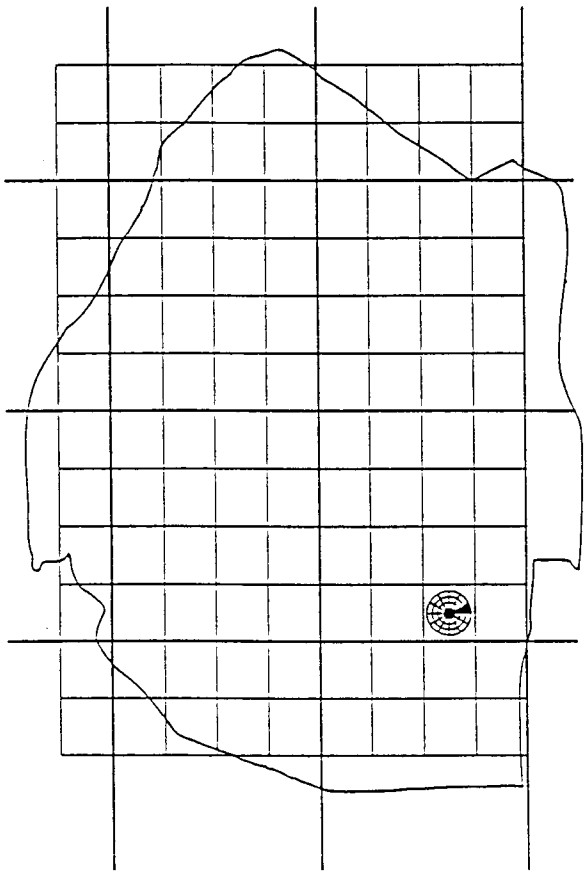
498. Sabota lark. (Mirafra sabota)

Recording frequency: 258 (/2263) 11%.
Population estimate: 20 000.
Status: A breeding resident in the lowveld, common in the south, uncommon in the north and absent from the more densely wooded areas.
Habitat preference: Thorn savanna.



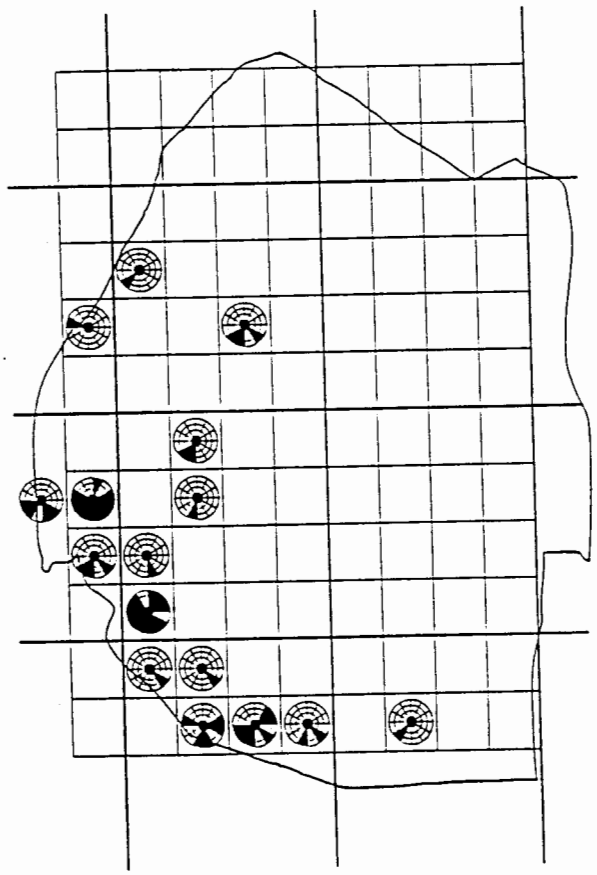
500. Longbilled lark. (Mirafra curvirostris)

Recording frequency: 3 (/2263) 0,15%.
Status: Rare visitor in the highveld.
Habitat preference: Grassland.



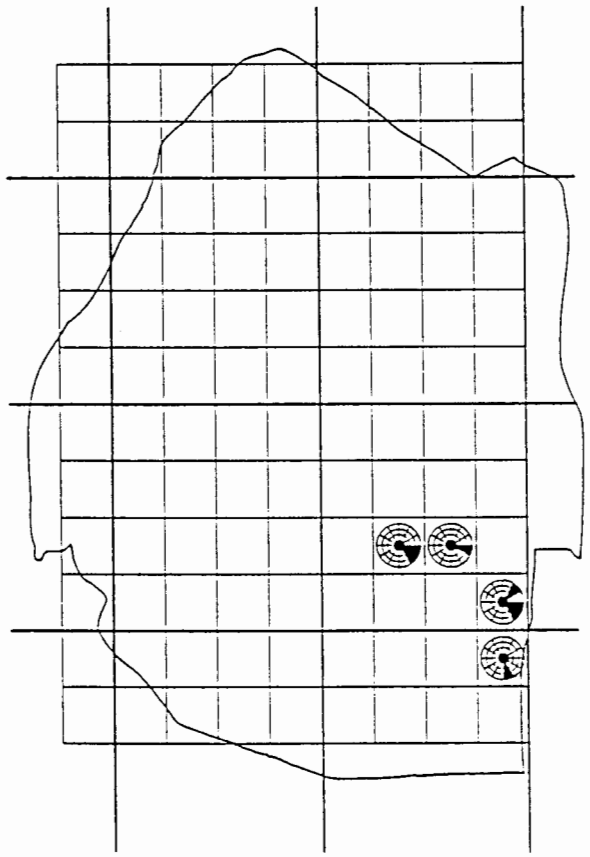
505. Dusky lark. (Pinarocorys nigricans)

A pair was seen in Acacia savanna near Nsoko (J9) in March 1991 (VP).



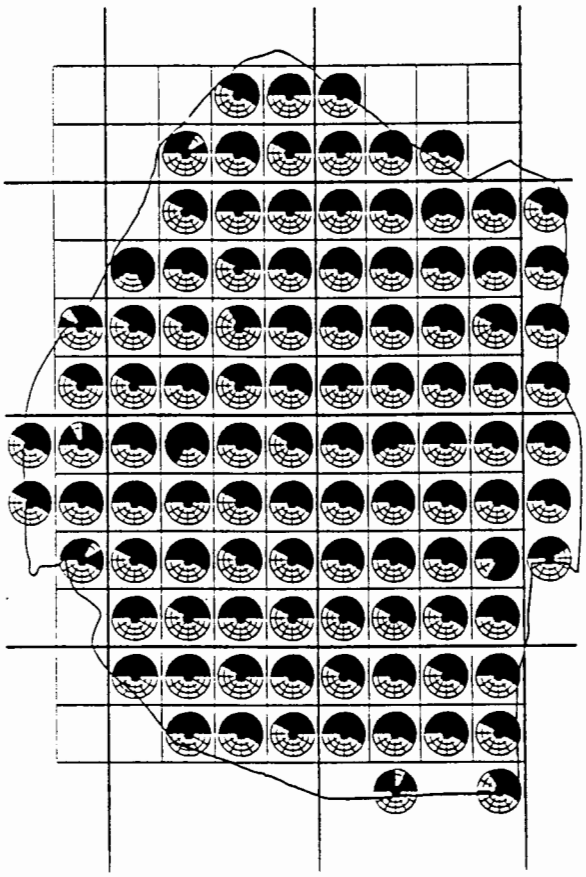
507. Redcapped lark. (Calandrella cinerea)

Recording frequency: 50 (/2263) 2%.
Population estimate: 1 000.
Status: An uncommon breeding resident in the southern highveld and rare visitor in the middleveld and northern highveld.
Habitat preference: Grassland with sparse grass cover.



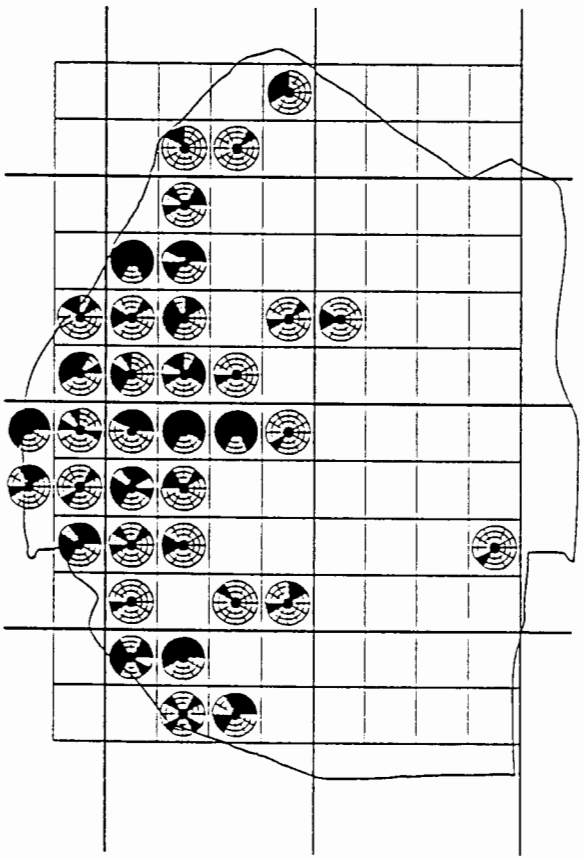
515. Chestnutbacked finchlark. (Eremopterix leucotis)

Recording frequency: 7 (/2263) 0,35%.
Population estimate: 100.
Status: Rare breeding resident in the southern lowveld. Recorded once in the northern lowveld during bush clearing operations in the 1970s (J. Culverwell).
Habitat preference: Thorn savanna and cultivated lands.



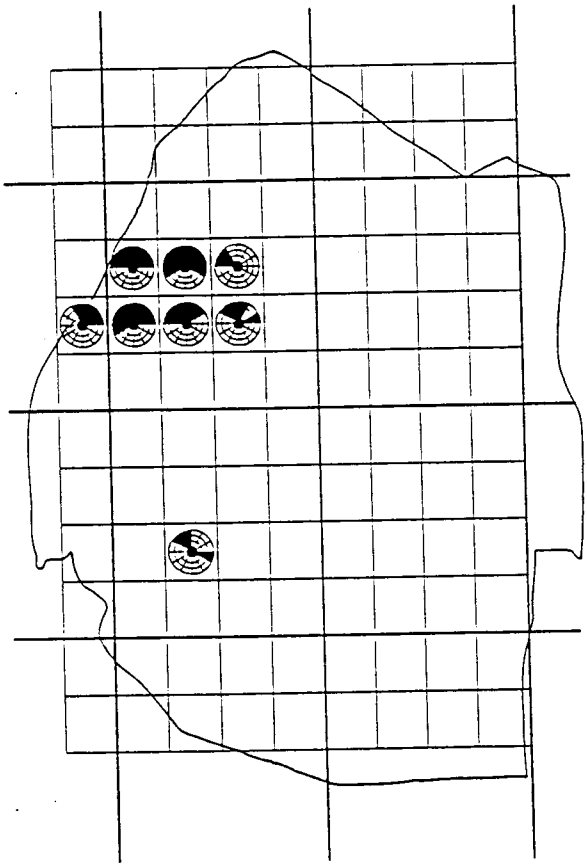
518. European swallow. (Hirundo rustica)

Recording frequency: 976 (/2263) 43%.
Status: Very common summer migrant.
Habitat preference: Encountered over all habitats.



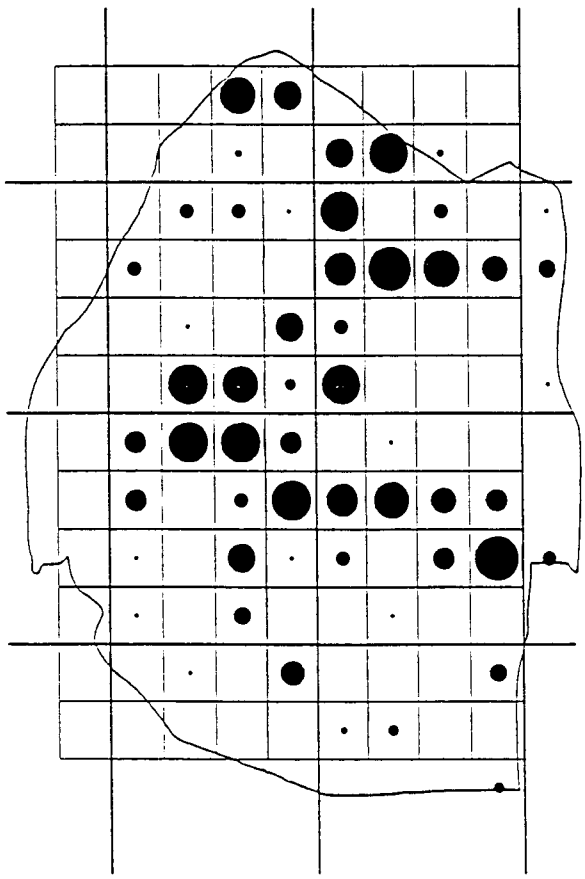
520. Whitethroated swallow. (Hirundo albigularis)

Recording frequency: 232 (/2263) 10%.
Population estimate: 2 000.
Status: Common breeding summer migrant in the highveld and middleveld.
Habitat preference: Grassland, vleis and cultivated land, usually near open water.



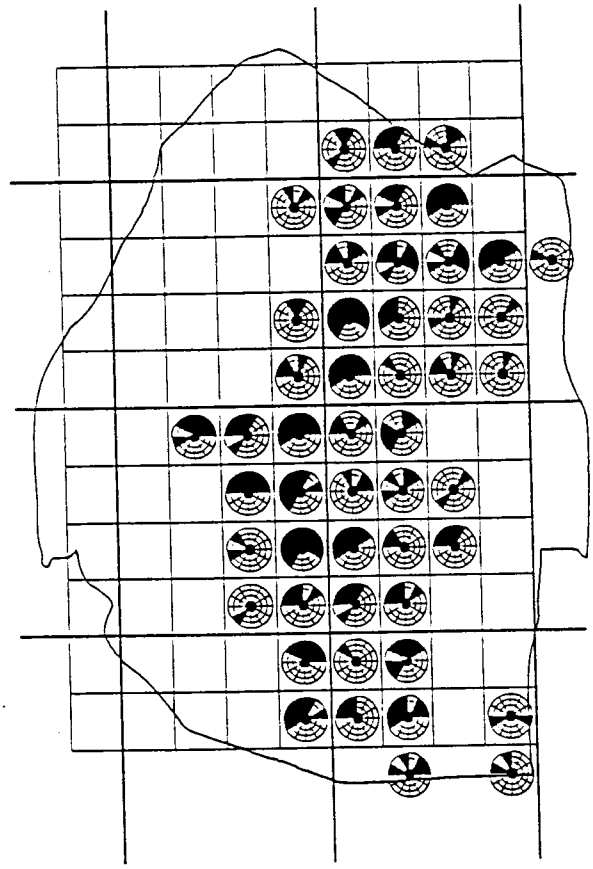
521. Blue swallow. (Hirundo atrocaerulea)

Recording frequency: 65 (/2263) 3%.
Population estimate: 30.
Status: Rare breeding summer migrant in the highveld. The species occurs at very low density, even in apparently suitable habitat. By comparison, the species occurs at a much higher density near Kaapse Hoop in the Transvaal (D. Allan pers. comm.), where it utilises disused mine shafts for nest sites. In Swaziland nests are usually situated in natural sink holes. The number of suitable holes available does not appear to be a limiting factor, as many apparently suitable holes remain unused. However, the instability of the sink holes is a factor which significantly affects breeding success in Swaziland.
Habitat preference: Highveld grassland with particularly dense grass cover on gentle granitic slopes above 1250 m altitude.



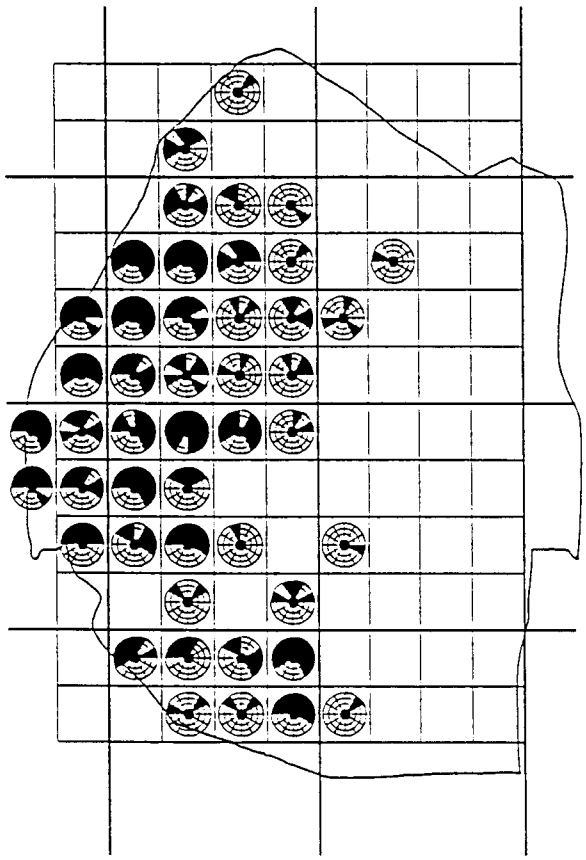
522. Wiretailed swallow. (Hirundo smithii)

Recording frequency: 402 (/2263) 18%.
Population estimate: 4 000.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos and rare in the highveld.
Habitat preference: Usually associated with rivers, streams and dams and nests on bridges or other buildings.



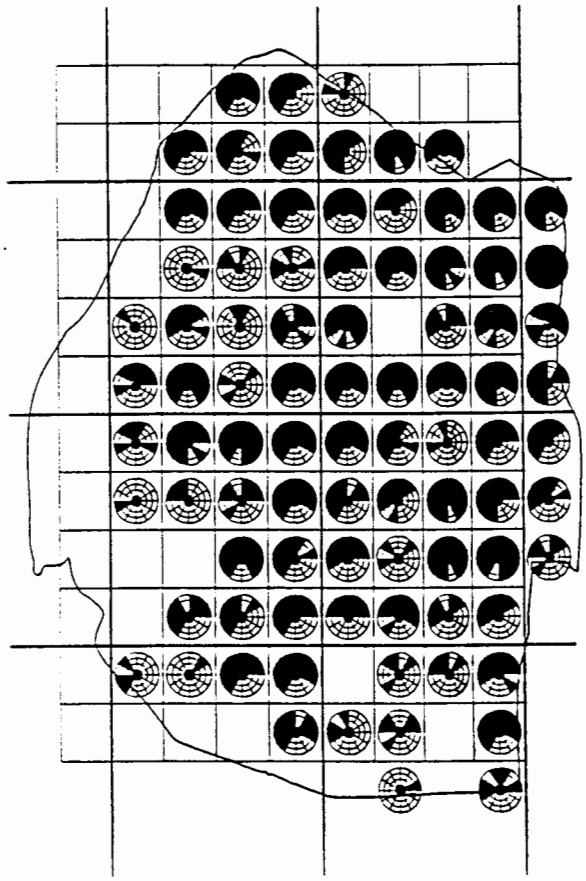
524. Redbreasted swallow. (Hirundo semirufa)

Recording frequency: 218 (/2263) 10%.
Population estimate: 1 000.
Status: Uncommon breeding summer migrant in the middleveld and lowveld.
Habitat preference: Savanna. Usually nests in road culverts.



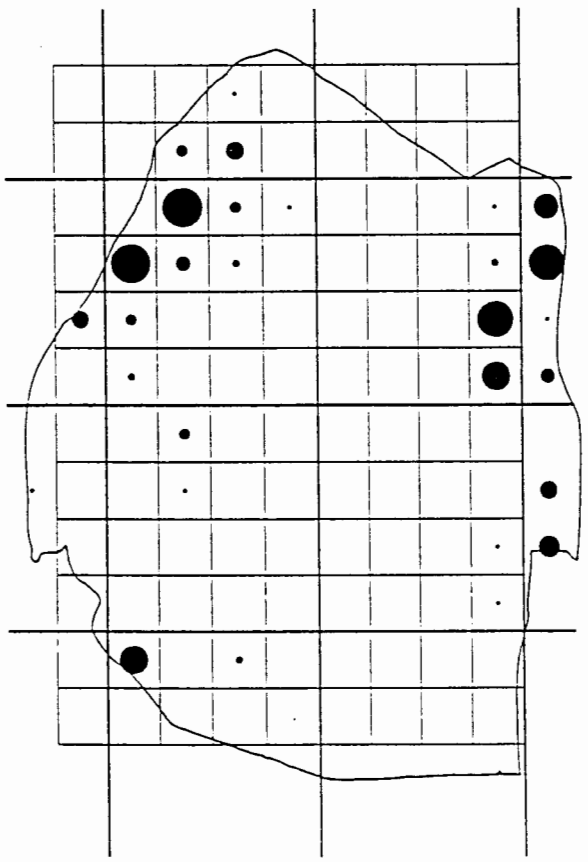
526. Greater striped swallow. (Hirundo cucullata)

Recording frequency: 319 (/2263) 14%.
Population estimate: 5 000.
Status: Common breeding summer migrant in the highveld and middleveld.
Habitat preference: Seen over all habitats except forest. Usually breeds on buildings.



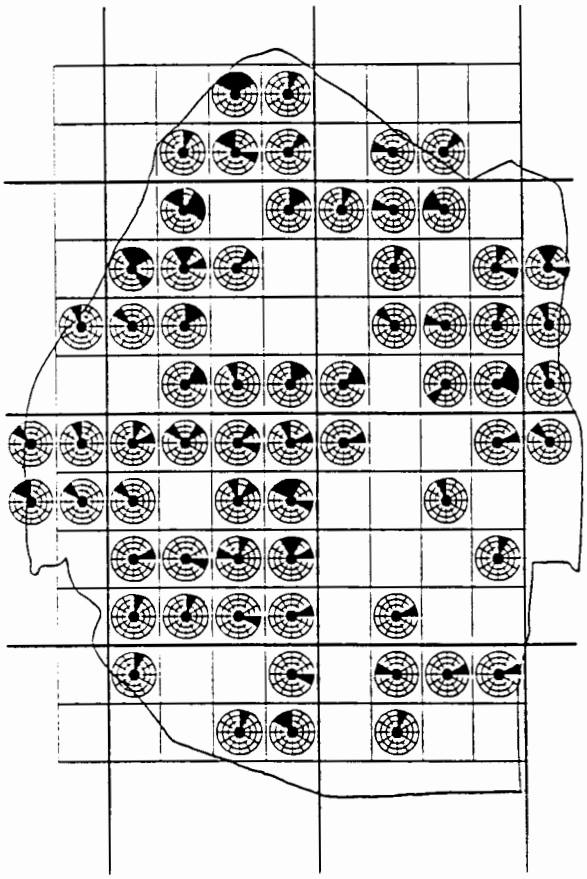
527. Lesser striped swallow. (Hirundo abyssinica)

Recording frequency: 888 (/2263) 39%.
Population estimate: 40 000.
Status: Very common breeding summer migrant in the middleveld, lowveld and Lubombos and vagrant in the highveld.
Habitat preference: Woodland and savanna. Breeds on buildings and cliffs.



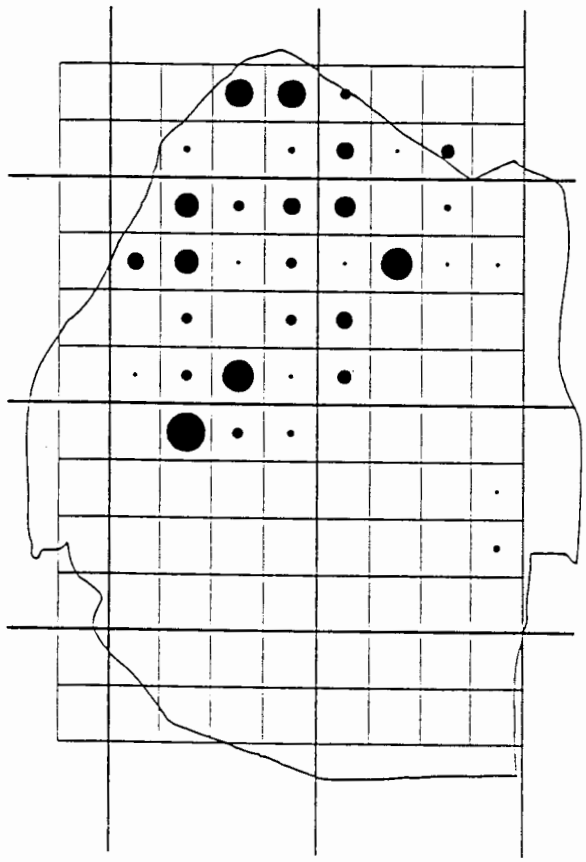
529. Rock martin. (Hirundo fuligula)

Recording frequency: 163 (/2263) 7%.
Population estimate: 600.
Status: Uncommon breeding resident in the highveld and Lubombos and visitor to the adjoining lowveld.
Habitat preference: Seen over all habitats. Breeds on cliffs.



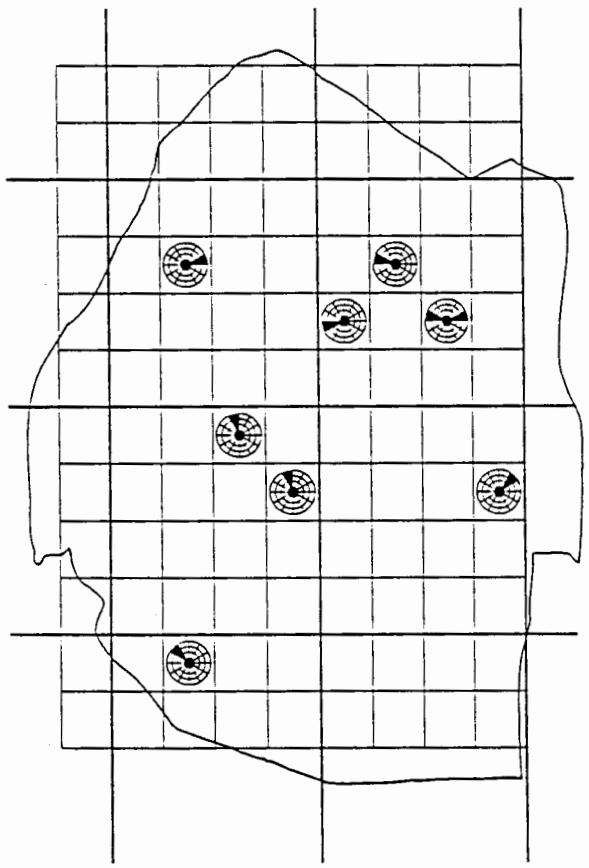
530. House martin. (Delichon urbica)

Recording frequency: 111 (/2263) 5%.
Status: Uncommon summer migrant.
Habitat preference: Seen over all habitat types.



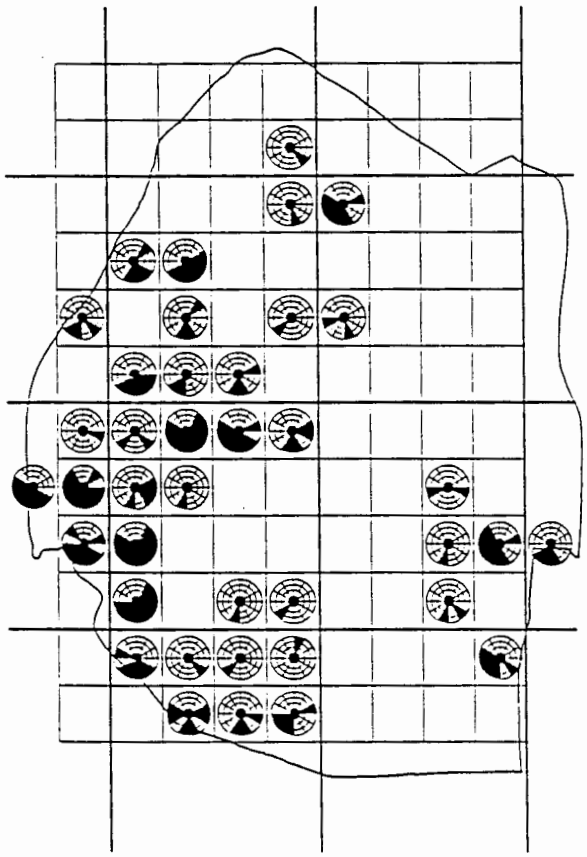
531. Greyrumped swallow. (Pseudhirundo griseopyga)

Recording frequency: 174 (/2263) 8%.
Population estimate: 1 000.
Status: Uncommon breeding resident only in the north of the highveld, middleveld and lowveld, and a vagrant to the south.
Habitat preference: Grassland and savanna.



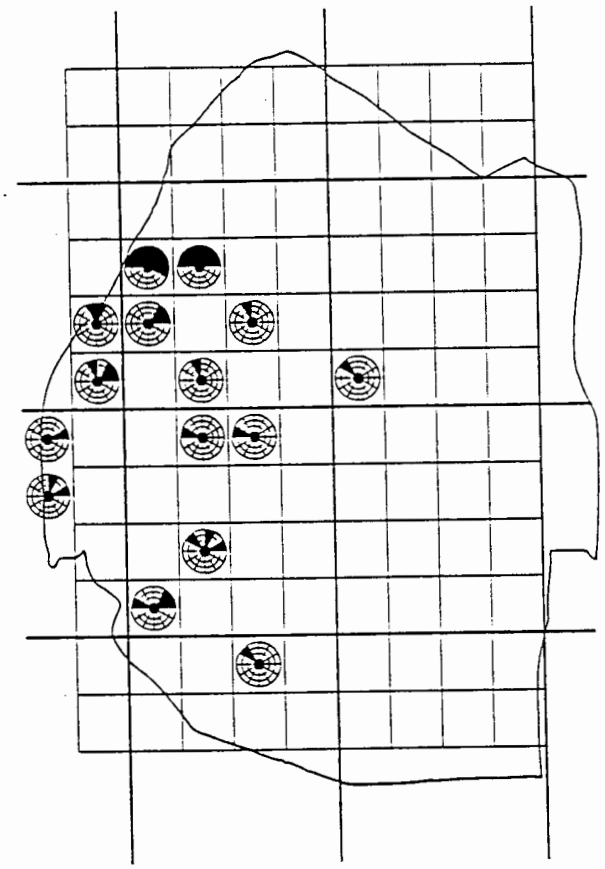
532. Sand martin. (Riparia riparia)

Recording frequency: 9 (/2263) 0,45%.
Status: Rare summer migrant.
Habitat preference: Grassland and savanna.



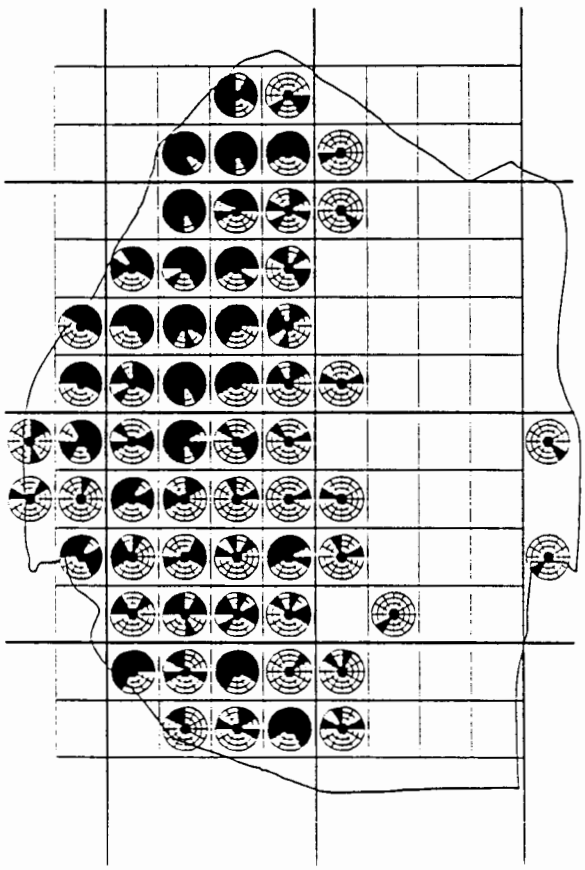
533. Brownthroated martin. (Riparia paludicola)

Recording frequency: 175 (/2263) 8%.
Population estimate: 800.
Status: Uncommon breeding resident in the highveld, middleveld and south eastern lowveld (along the Usutu and Ingwavuma rivers)
Habitat preference: Grassland, savanna and vleis, usually near rivers. Breeds in river banks.



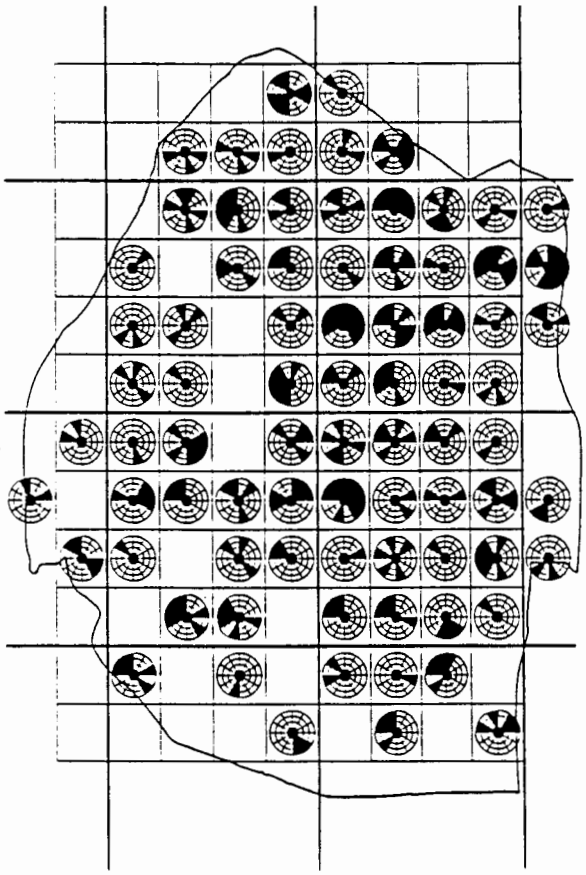
534. Banded martin. (Riparia cincta)

Recording frequency: 44 (/2263) 2%.
Population estimate: 200.
Status: Uncommon breeding summer migrant in the highveld and vagrant in the middleveld.
Habitat preference: Grassland.



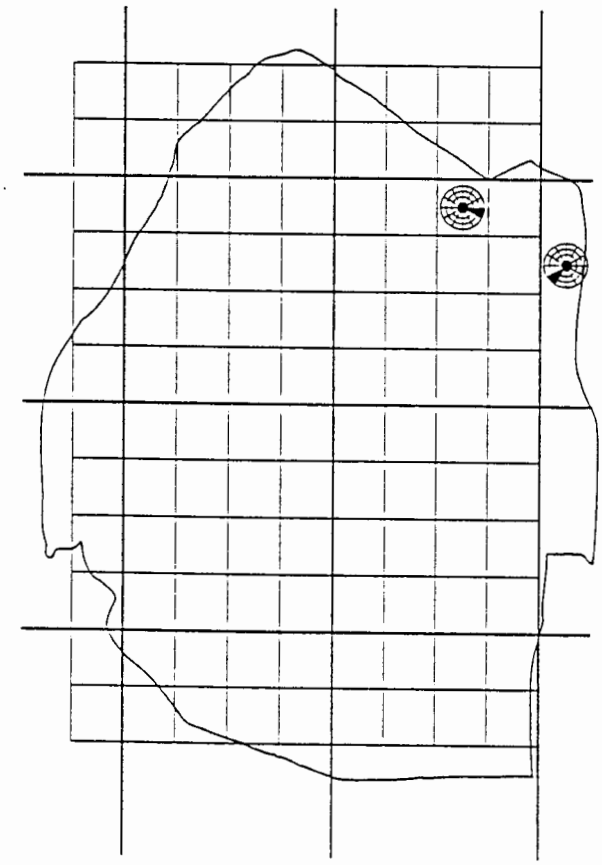
536. Black sawwing swallow. (Psalidoprocne holomelas)

Recording frequency: 430 (/2263) 19%.
Population estimate: 5 000.
Status: Common breeding resident in the highveld and middleveld.
Habitat preference: Seen over all habitat types. Breeds in sandbanks and dongas.



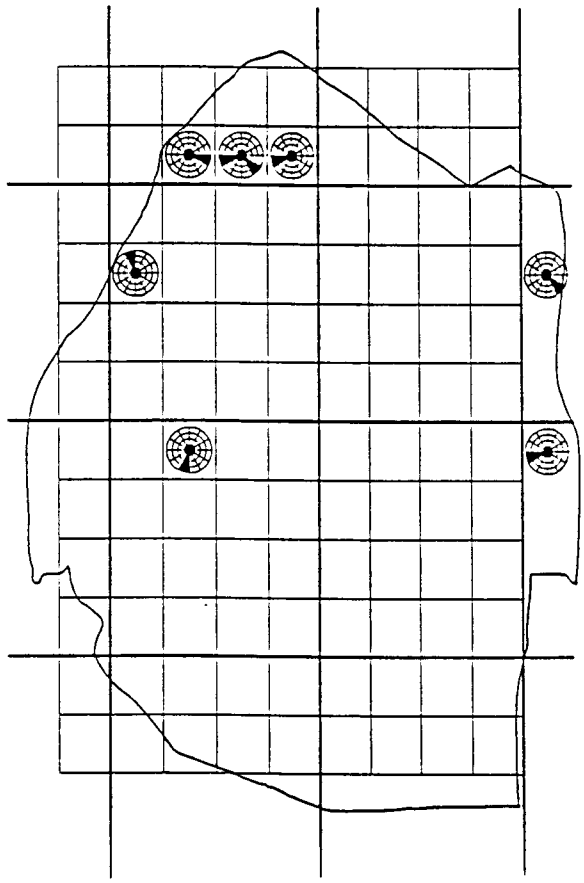
538. Black cuckooshrike. (Campephaga flava)

Recording frequency: 312 (/2263) 14%.
Population estimate: 4 000.
Status: Uncommon breeding resident.
Habitat preference: Woodland and savanna.



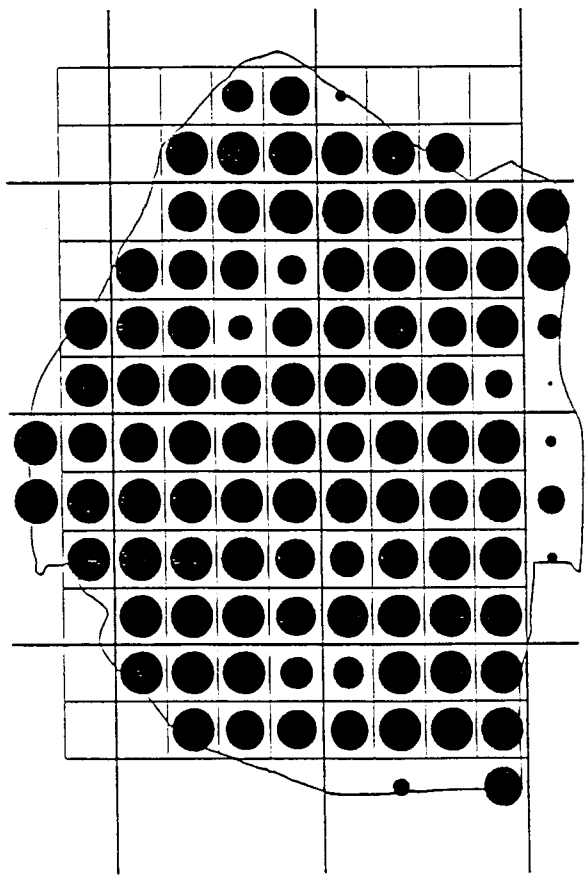
539. Whitebreasted cuckooshrike. (Coracina pectoralis)

Single birds were seen in Acacia savanna at Mhlume (C9) in April 1986 (VP) and at Mlawula (D11) in August 1987 (D. & D. Hill)



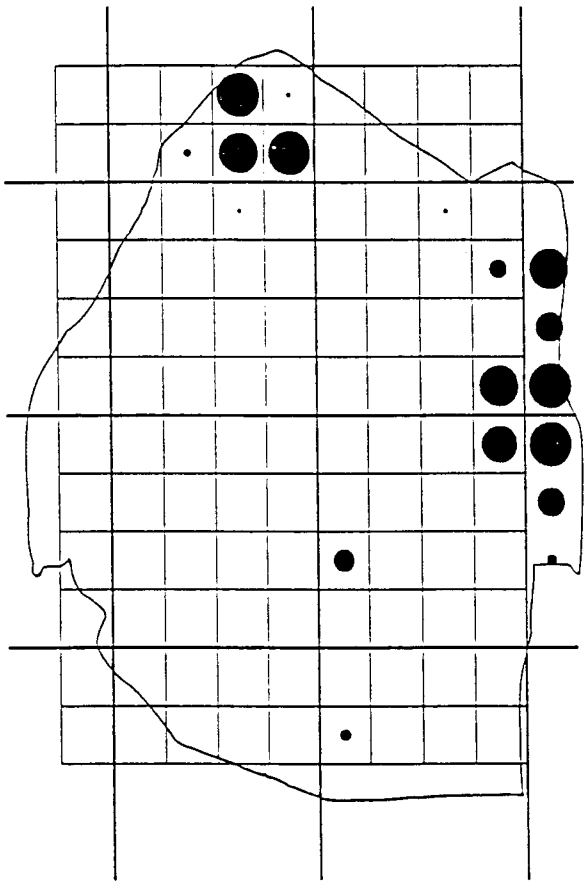
540. Grey cuckooshrike. (Coracina caesia)

Recording frequency: 8 (/2263) 0,4%.
Population estimate: 100.
Status: Rare breeding resident in the highveld, middleveld and Lubombos.
Habitat preference: Forest.



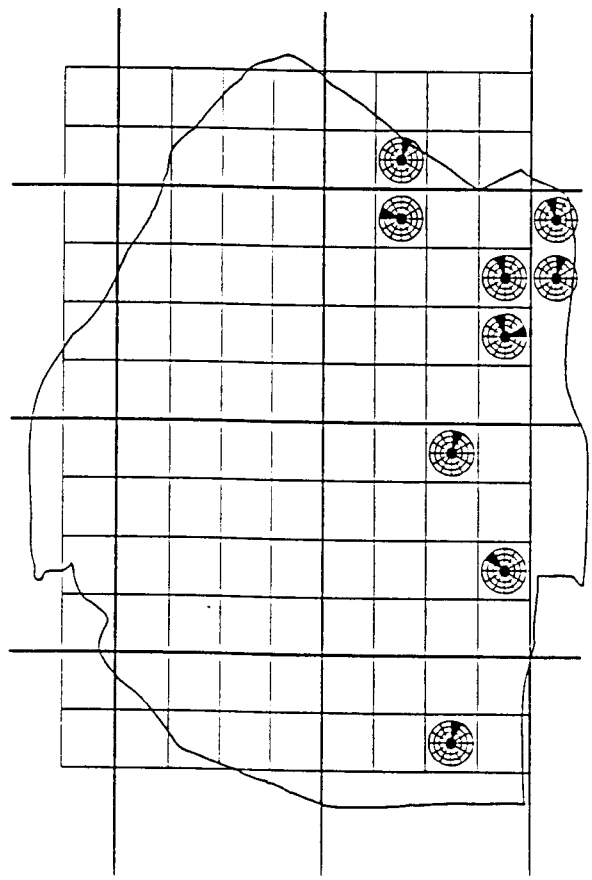
541. Forktailed drongo. (Dicrurus adsimilis)

Recording frequency: 1 882 (/2263) 83%.
Population estimate: 200 000.
Status: Very common breeding resident.
Habitat preference: Woodland, wattle stands and savanna.



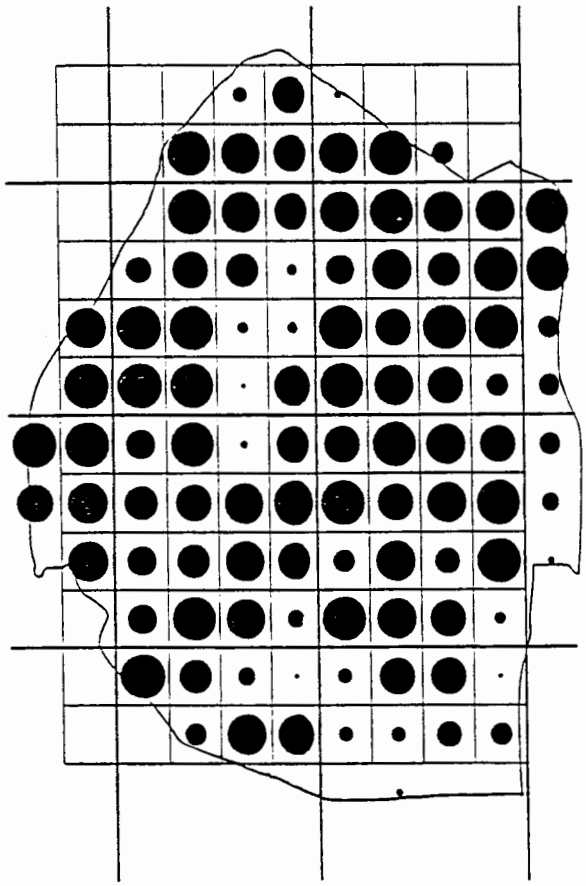
542. Squaretailed drongo. (Dicrurus ludwigii)

Recording frequency: 172 (/2263) 8%.
Population estimate: 1 200.
Status: Uncommon breeding resident in the middleveld and Lubombos.
Habitat preference: Forest.



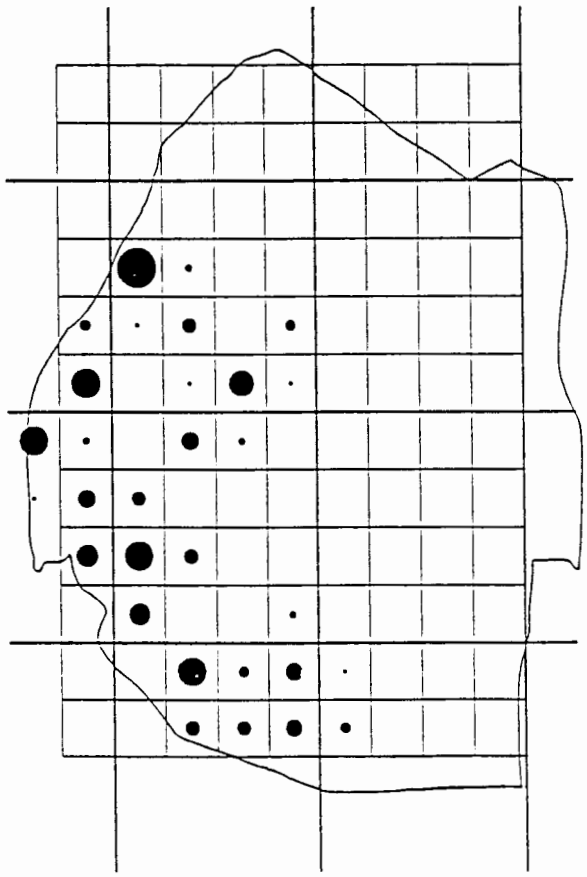
543. European golden oriole. (Oriolus oriolus)

Recording frequency: 11 (/2263) 0,5 %.
Status: Rare summer migrant in the lowveld.
Habitat preference: Woodland and savanna.



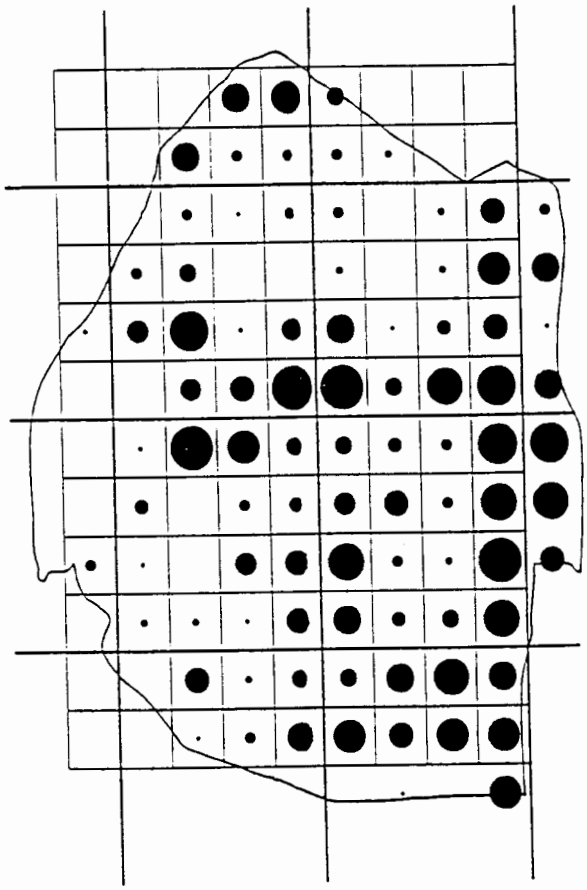
545. Blackheaded oriole. (Oriolus larvatus)

Recording frequency: 1 395 (/2263) 62%.
Population estimate: 10 000.
Status: Very common breeding resident.
Habitat preference: Woodland (including wattle stands in the highveld) and savanna.



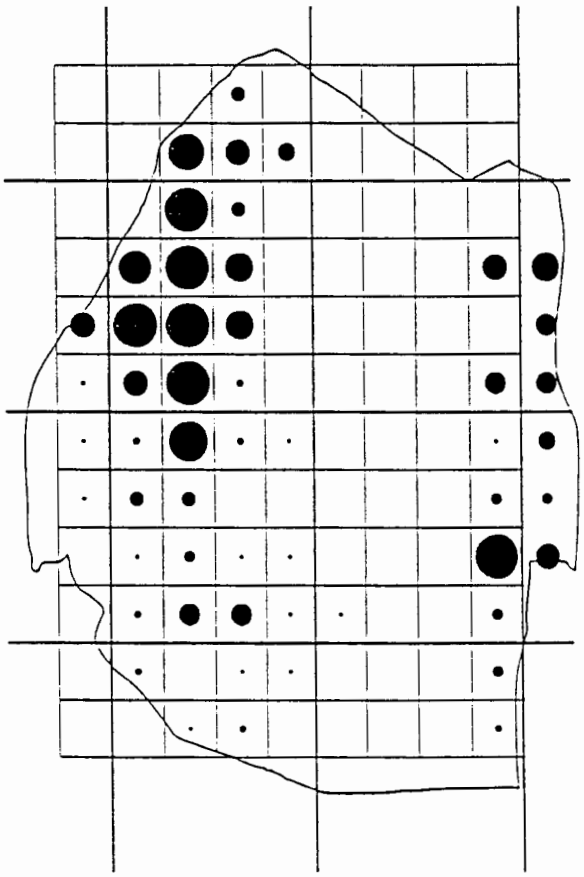
547. Black crow. (Corvus capensis)

Recording frequency: 151 (/2263) 7%.
Population estimate: 300.
Status: Uncommon breeding resident in the highveld and middleveld.
Habitat preference: Vleis and grassland.



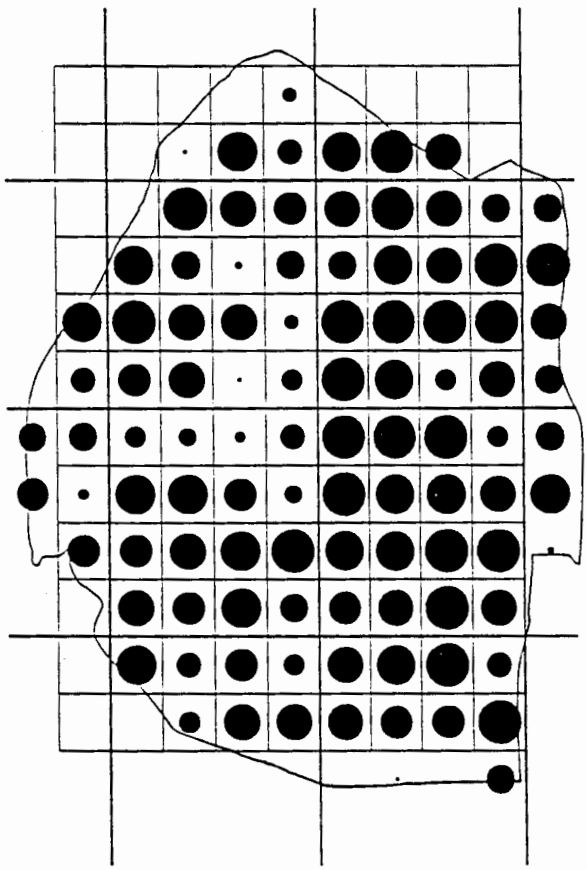
548. Pied crow. (Corvus albus)

Recording frequency: 786 (/2263) 35%.
Population estimate: 10 000.
Status: Common breeding resident, but uncommon in the highveld.
Habitat preference: Encountered in all habitats except forest.



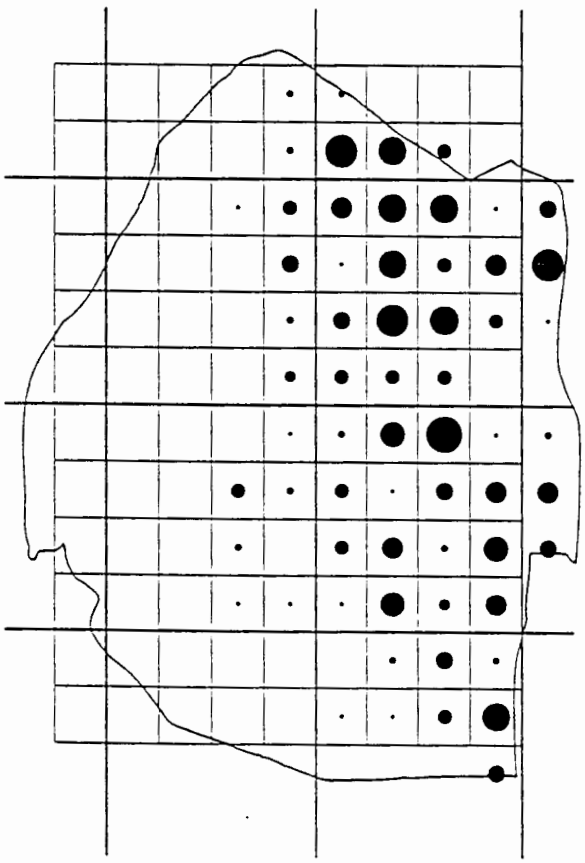
550. Whitenecked raven. (Corvus albicollis)

Recording frequency: 507 (/2263) 22%.
Population estimate: 5 000.
Status: Common breeding resident in the highveld and Lubombos and a common visitor to the adjoining lowveld. In the southern lowveld around Big Bend (I10), flocks numbering up to 100 birds are encountered in cultivated lands during the winter, and very few birds are to be found in the same localities in summer.
Habitat preference: Usually encountered in mountainous terrain but seen over all habitat types.



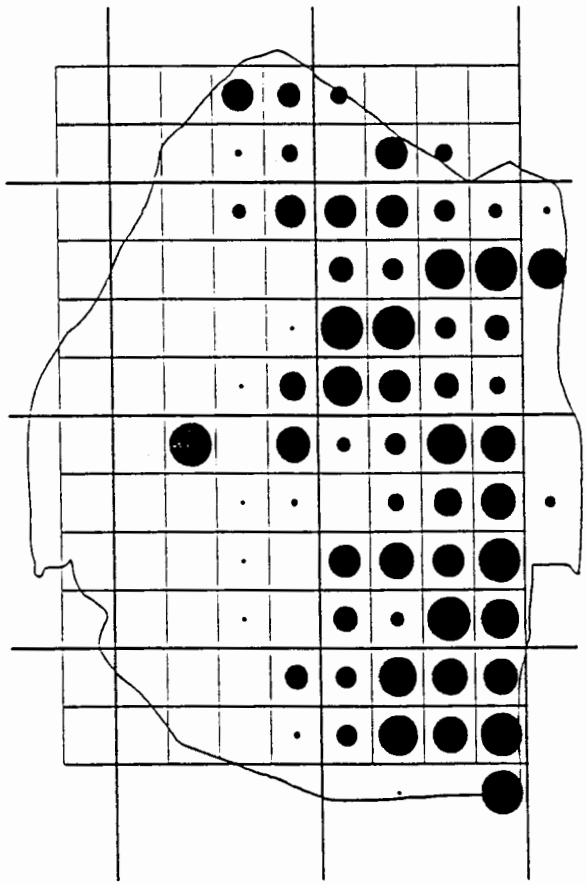
554. Southern black tit. (Parus niger)

Recording frequency: 1 130 (/2263) 50%.
Population estimate: 15 000.
Status: Common breeding resident.
Habitat preference: Woodland (including wattle stands in the highveld) and savanna.



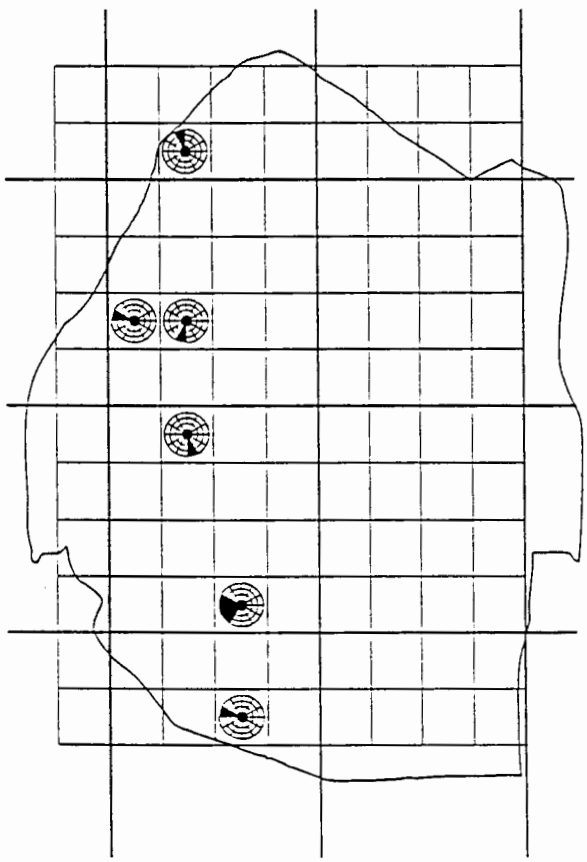
558. Grey penduline tit. (Anthoscopus caroli)

Recording frequency: 275 (/2263) 12%.
Population estimate: 3 000.
Status: Uncommon breeding resident in the lowveld and Lubombos and uncommon visitor in the middleveld.
Habitat preference: Woodland and savanna.



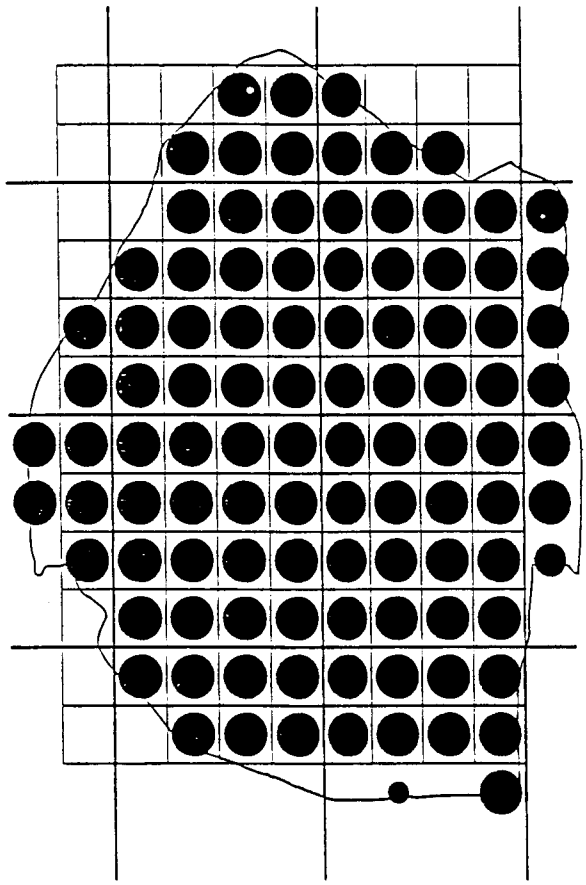
560. Arrowmarked babbler. (Turdoides jardineii)

Recording frequency: 604 (/2263) 27%.
Population estimate: 5 000.
Status: A breeding resident, common in the lowveld and uncommon in the middleveld and Lubombos.
Habitat preference: Woodland and savanna.



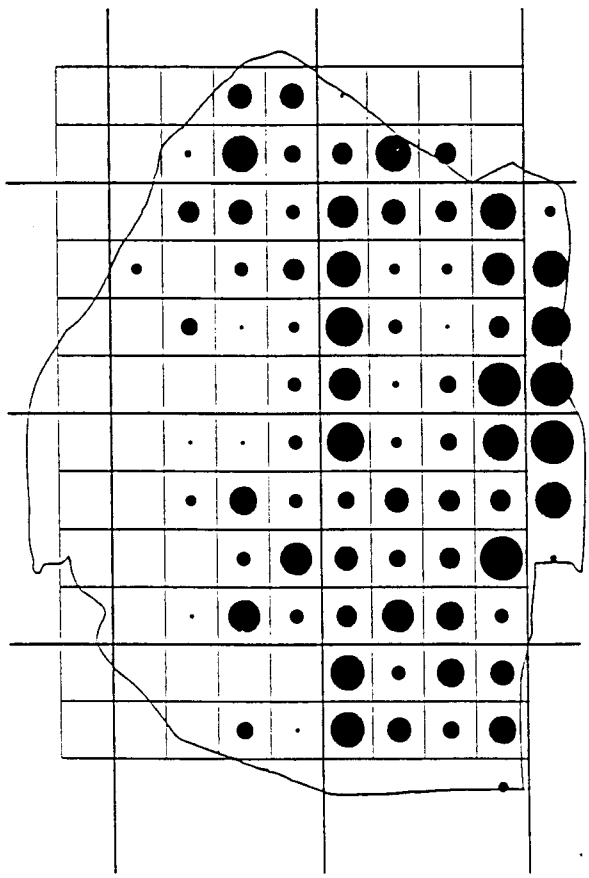
565. Bush blackcap. (Lioptilus nigricapillus)

Recording frequency: 9 (/2263) 0,4%.
Population estimate: 40.
Status: Rare, probably a breeding resident in the highveld.
Habitat preference: Within Swaziland this species was always encountered within natural forests. By contrast, in the Transvaal it is found in thickets and forest edges (Tarboton, Kemp and Kemp; Birds of the Transvaal).



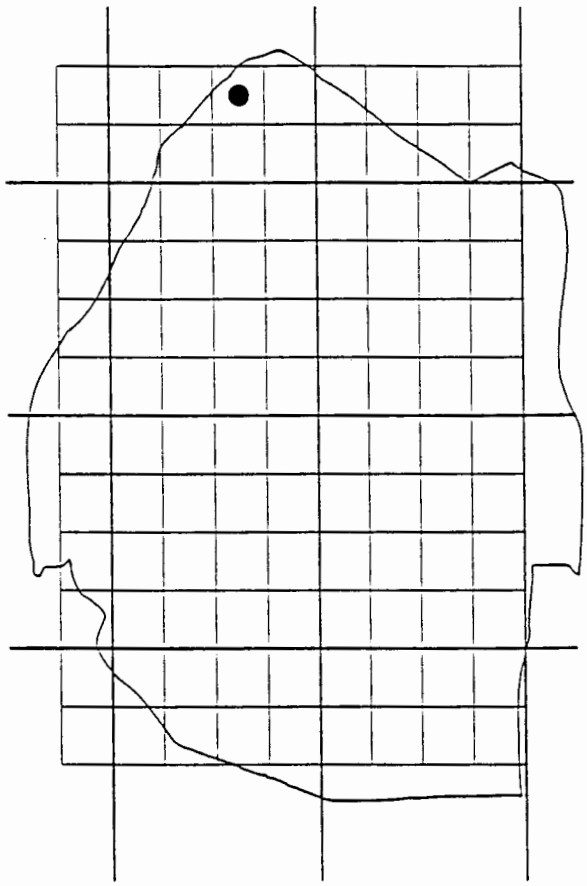
568. Blackeyed bulbul. (Pycnonotus barbatus)

Recording frequency: 2 138 (/2263) 94%.
Population estimate: 500 000.
Status: Very common breeding resident.
Habitat preference: Occurs in any habitat where trees are present.



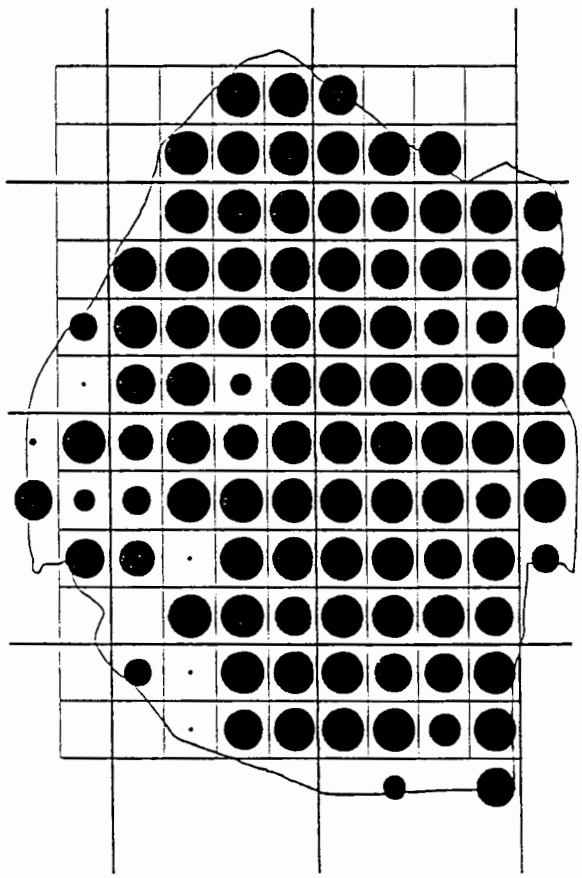
569. Terrestrial bulbul. (Phyllastrephus terrestris)

Recording frequency: 545 (/2263) 24%.
Population estimate: 5 000.
Status: A common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Forest and dense woodland.



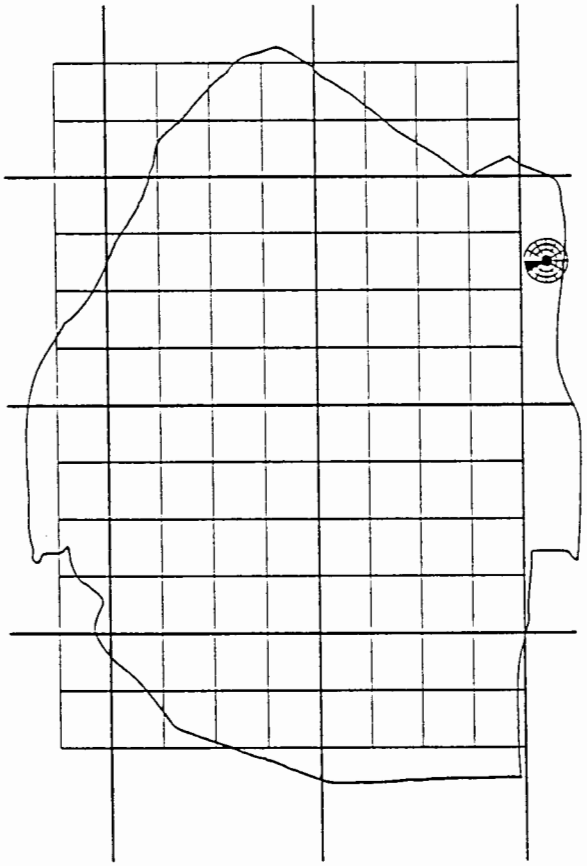
570. Yellowstreaked bulbul. (Phyllastrephus flavostriatus)

Recording frequency: 6 (/2263) 0,3%.
Population estimate: 20.
Status: Rare breeding resident, encountered only in the Mlumati Valley (A5).
Habitat preference: Forest.



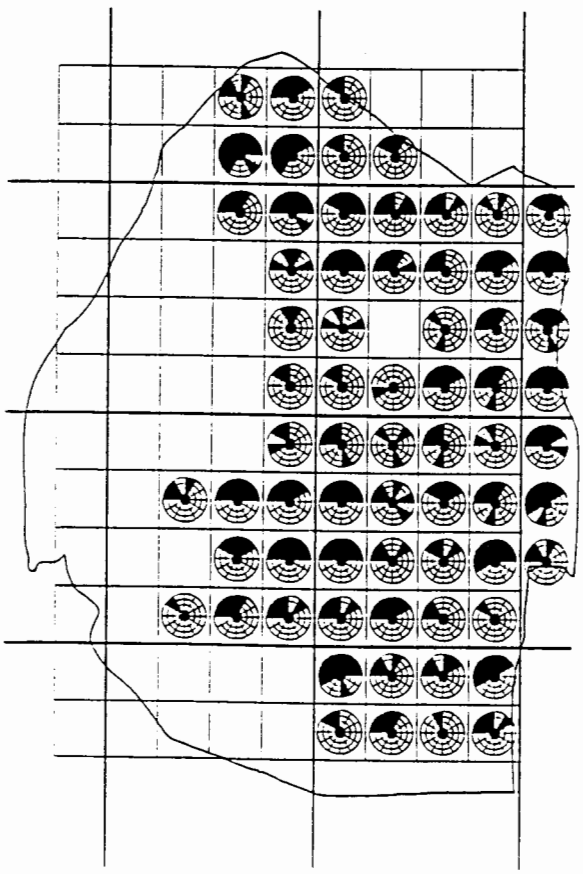
572. Sombre bulbul. (Andropadus importunus)

Recording frequency: 1 596 (/2263) 71%.
Population estimate: 200 000.
Status: A very common breeding resident in most areas but uncommon to rare in the far west.
Habitat preference: Woodland (including wattle stands) and forest.



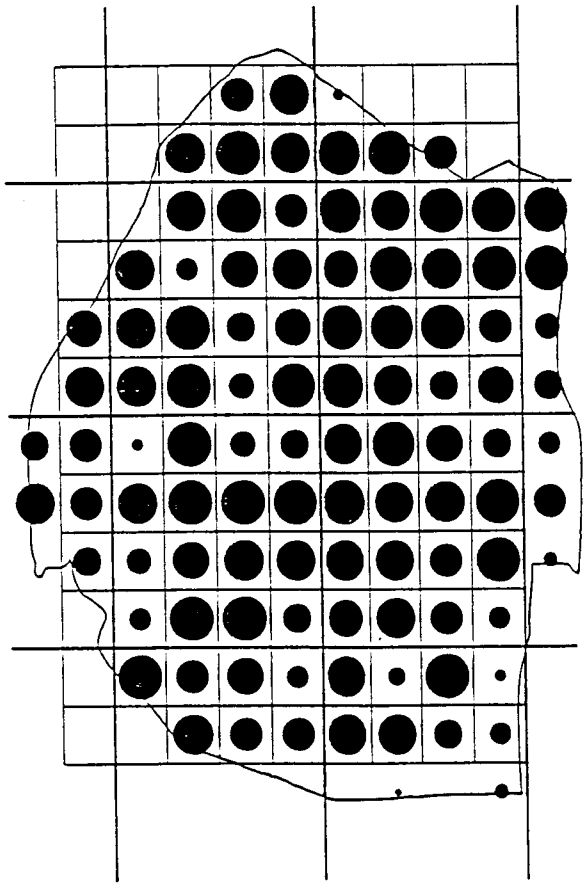
574. Yellowbellied bulbul. (Chlorocichla flaviventris)

Encountered only once near the Mocambique border in Mlawula (D11) in August 1988 (D. & D. Hill)



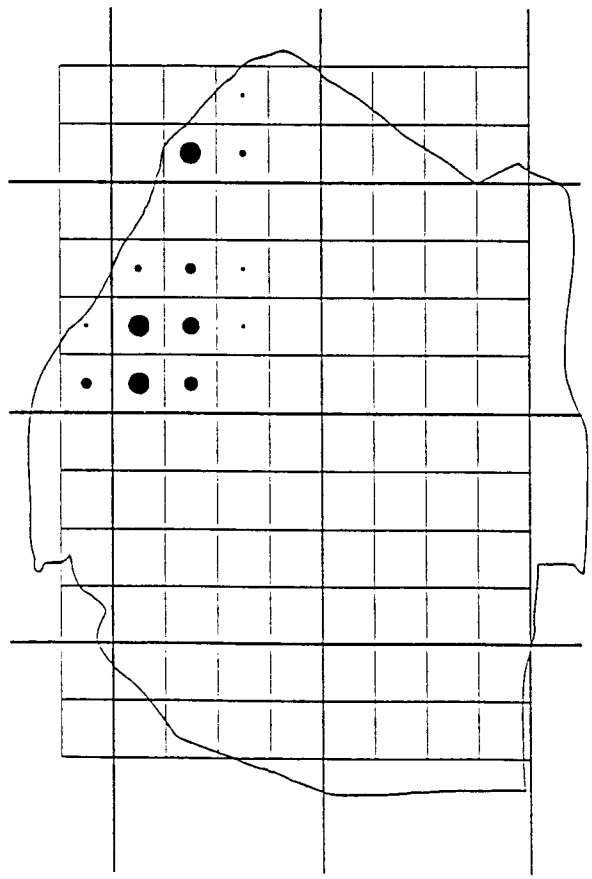
575. Yellowspotted nicator. (Nicator gularis)

Recording frequency: 311 (/2263) 14%.
Population estimate: 7 000.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos. Seldom recorded in winter as it is difficult to detect when not calling.
Habitat preference: Woodland.



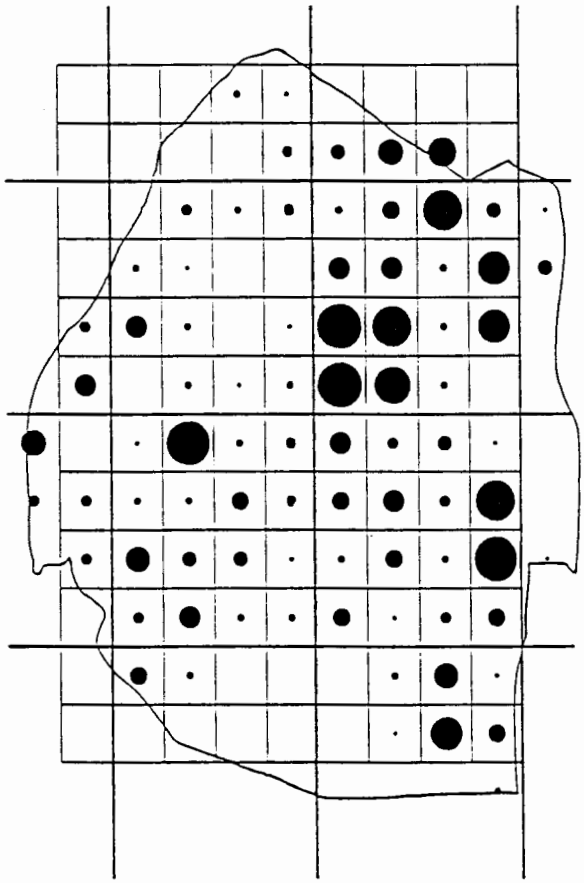
576. Kurrichane thrush. (Turdus libonyana)

Recording frequency: 1 552 (/2263) 69%.
Population estimate: 200 000.
Status: Very common breeding resident.
Habitat preference: Woodland and savanna.



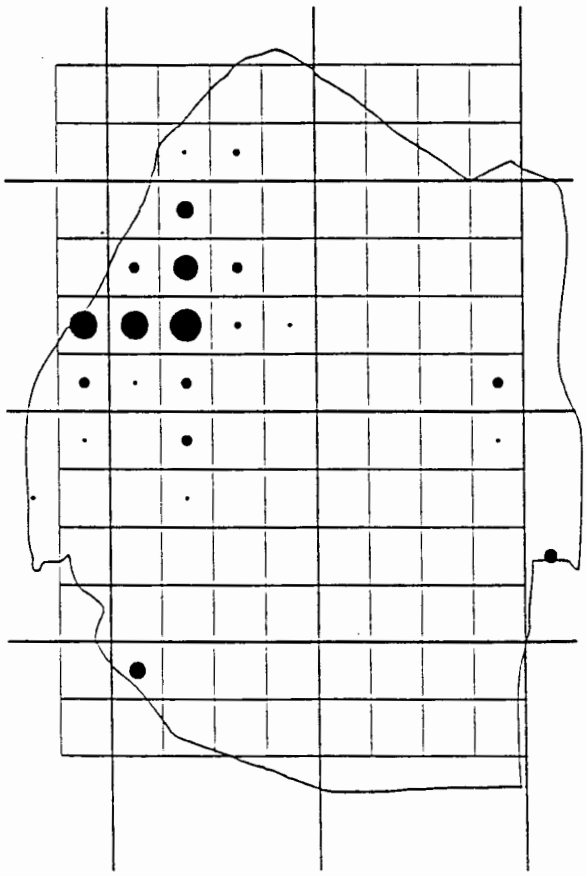
577. Olive thrush. (Turdus olivaceus)

Recording frequency: 49 (/2263) 2%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the northern highveld.
Habitat preference: Forest.



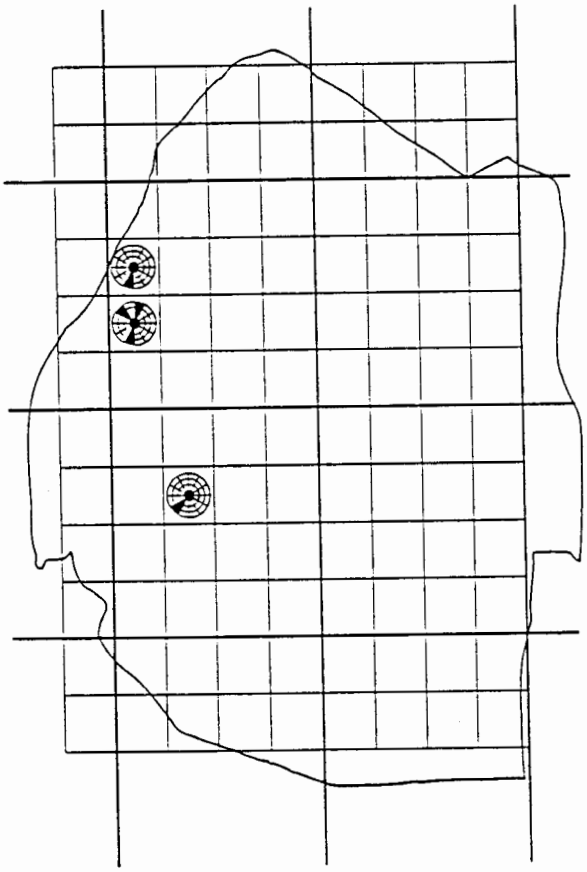
580. Groundscraper thrush. (Turdus litsitsirupa)

Recording frequency: 507 (/2263) 22%.
Population estimate: 6 000.
Status: Common breeding resident.
Habitat preference: Savanna, cultivated lands and lawns in urban areas.



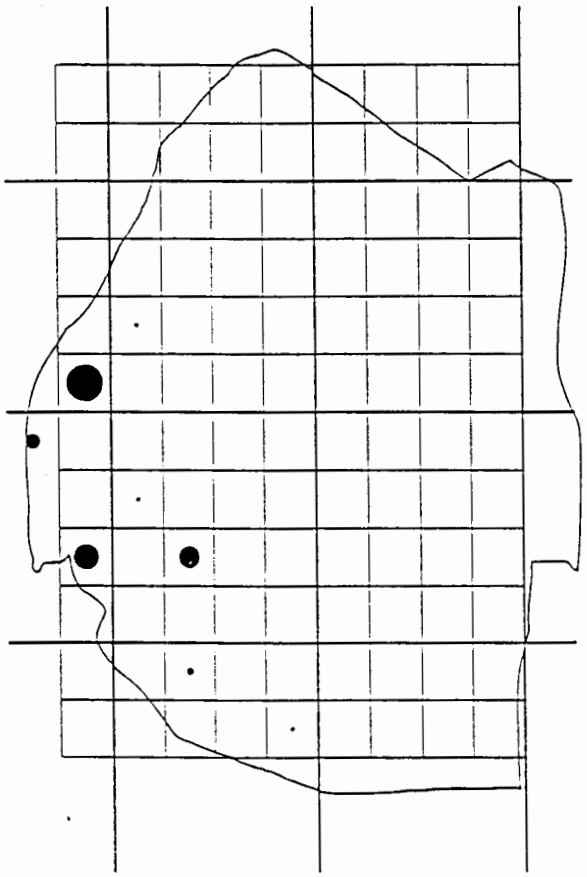
581. Cape rock thrush. (Monticola rupestris)

Recording frequency: 8 (/2263) 4%.
Population estimate: 600.
Status: A breeding resident, uncommon in the highveld and rare in the Lubombos.
Habitat preference: Rocky outcrops.



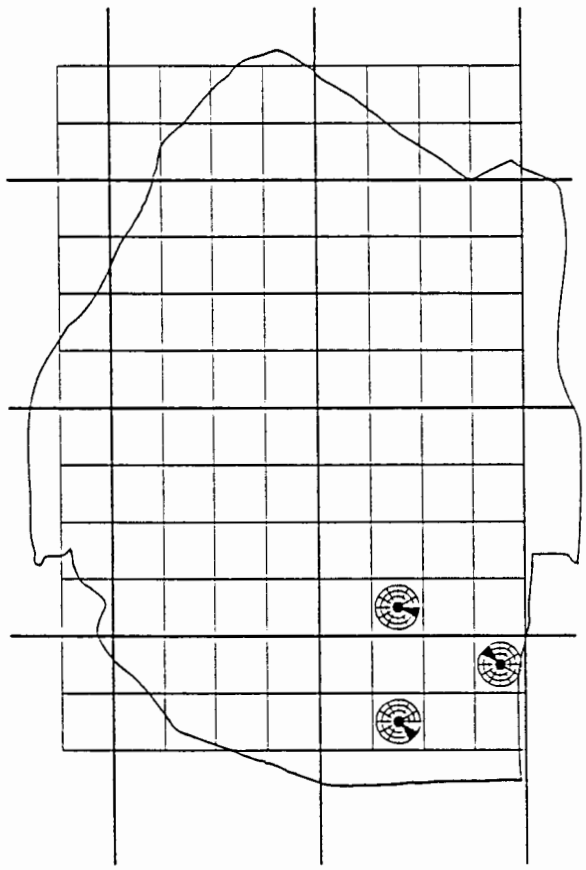
582. Sentinel rock thrush. (Monticola explorator)

Recording frequency: 5 (/2263) 0,3%.
Status: Rare. It is not clear whether the species is a breeding resident or an occasional visitor in the highveld.
Habitat preference: Rocky outcrops in highveld grassland.



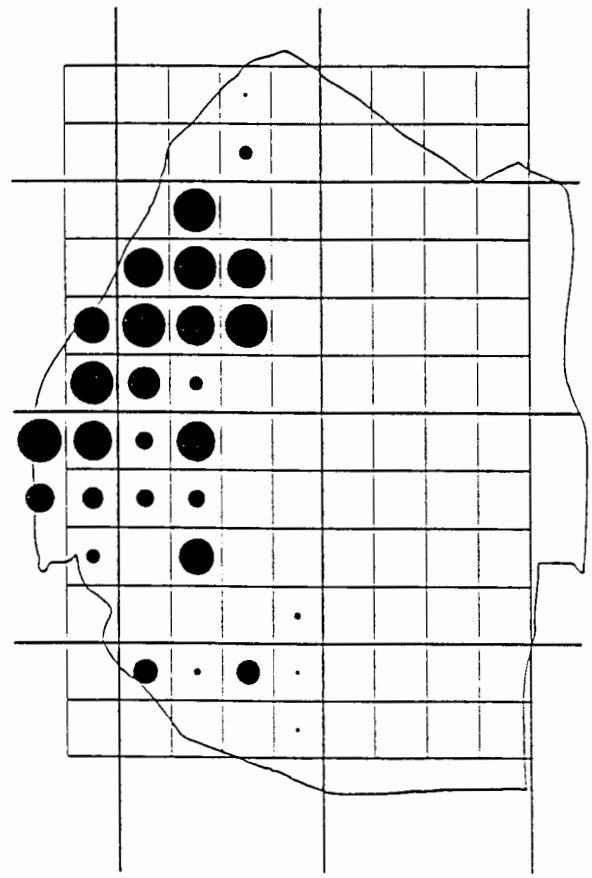
586. Mountain chat. (Oenanthe monticola)

Recording frequency: 32 (/2263) 1%.
Population estimate: 80.
Status: Uncommon breeding resident in the southern highveld.
Habitat preference: Rocky outcrops in highveld grassland.



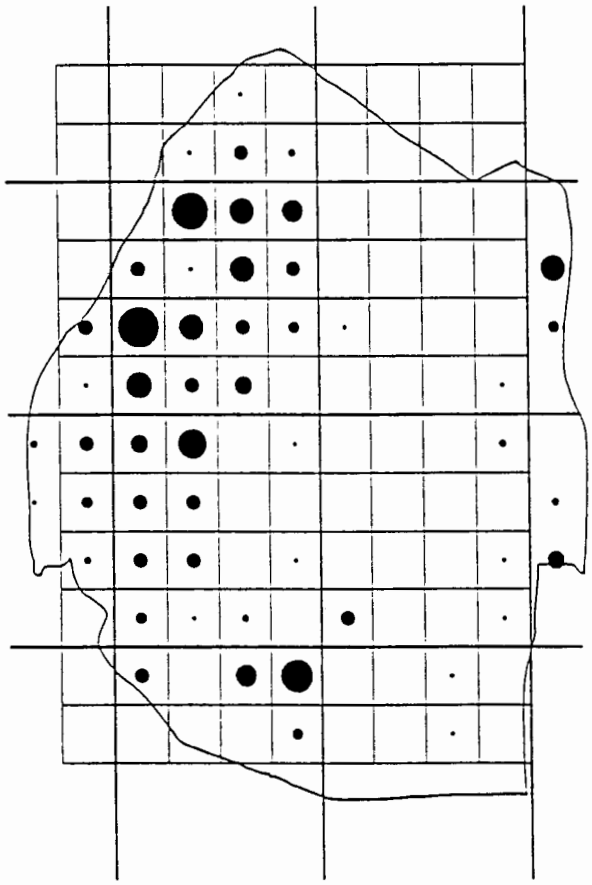
587. Capped wheatear. (Oenanthe pileata)

Single birds were seen in disturbed ground associated with human habitation at Nsoko (K10) in November 1989 (VP), near Sithobela (J8) in April 1990 (VP) and near Hluti (L8) in May 1990 (VP).



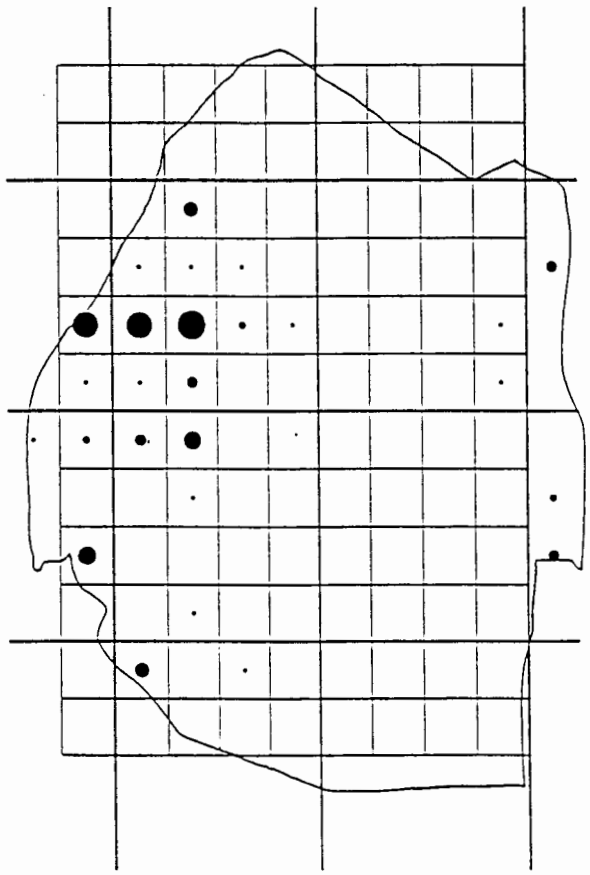
588. Buffstreaked chat. (Oenanthe bifasciata)

Recording frequency: 309 (/2263) 14%.
Population estimate: 4 000.
Status: Common breeding resident in the highveld.
Habitat preference: Rocky outcrops in highveld grassland.



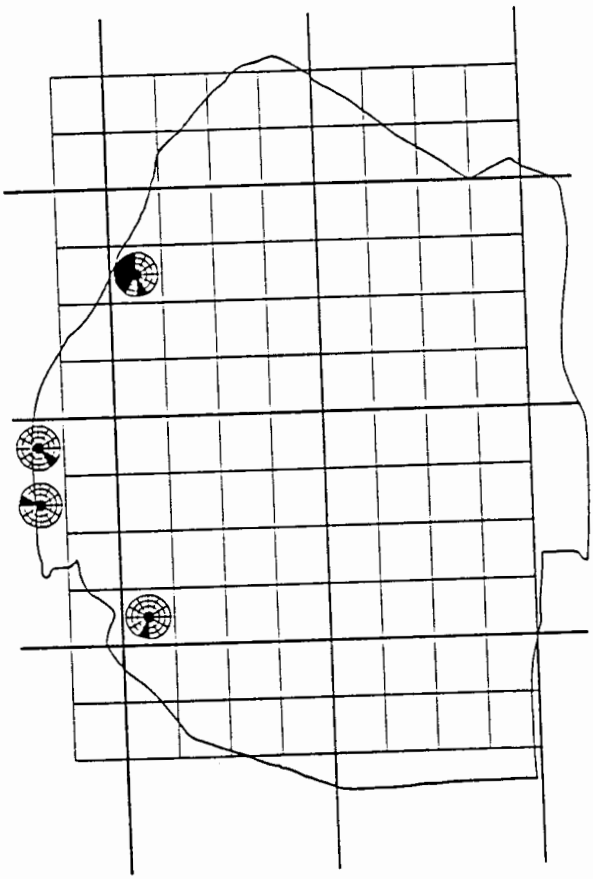
589. Familiar chat. (Cercomela familiaris)

Recording frequency: 32 (/2263) 10%.
Population estimate: 2 000.
Status: A breeding resident, common in the highveld, uncommon in the middleveld and Lubombos and rare in the lowveld.
Habitat preference: Rocky terrain in grassland and savanna.



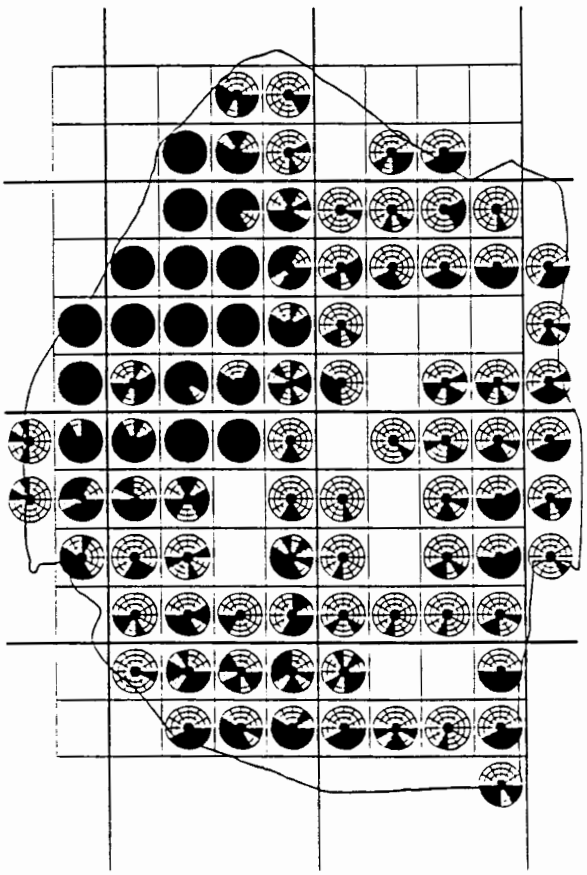
593. Mocking chat. (Thamnolaea cinnamomeiventris)

Recording frequency: 78 (/2263) 3%.
Population estimate: 400.
Status: Uncommon breeding resident in the highveld, middleveld and Lubombos.
Habitat preference: Rocky terrain in savanna and woodland.



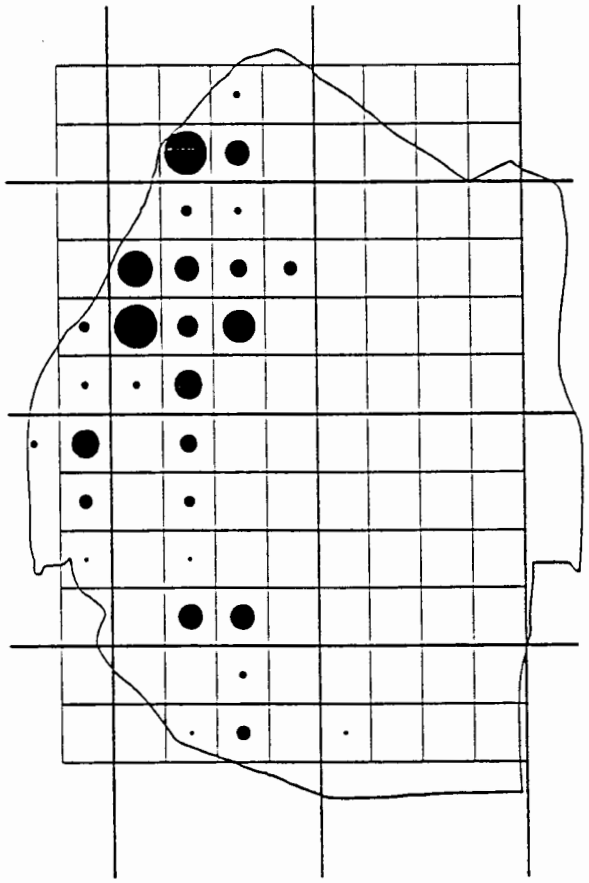
595. Anteating chat. (Myrmecocichla formicivora)

Recording frequency: 8 (/2263) 0,4%.
Status: Uncommon visitor in the highveld. Had not been recorded at all in Swaziland until October 1989 and has been seen several times since then.
Habitat preference: Grassland.



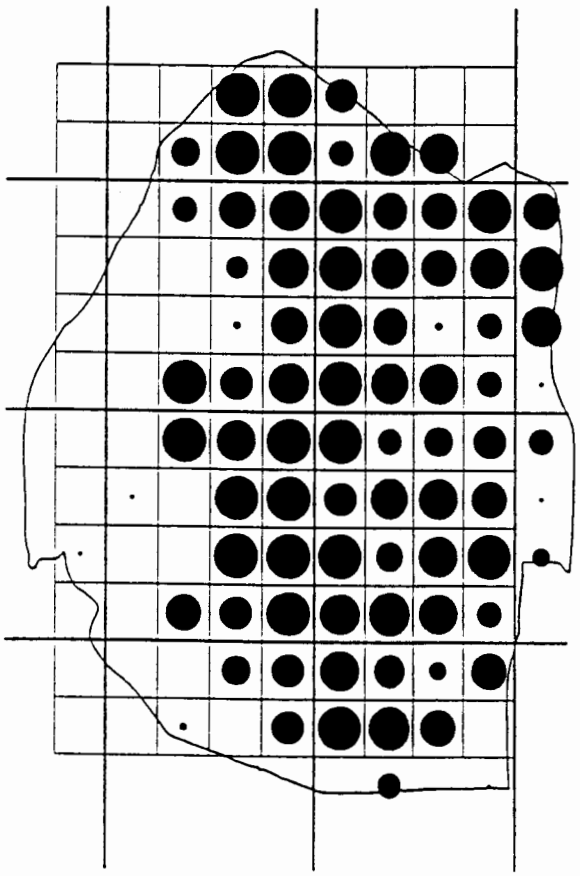
596. Stonechat. (Saxicola torquata)

Recording frequency: 844 (/2263) 37%.
Population estimate: 8 000.
Status: Common breeding resident in the highveld and middleveld and winter migrant in the lowveld and Lubombos. The highveld population does not appear to be depleted in the winter and the migratory birds in the lowveld and Lubombos presumably come from outside the borders of Swaziland.
Habitat preference: Grassland, vleis, cultivated lands and savanna.



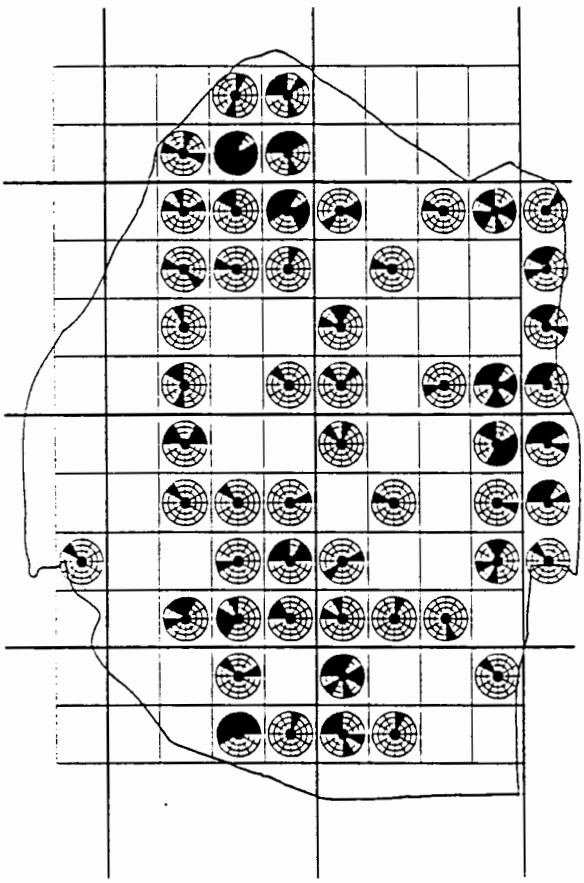
598. Chorister robin. (Cossypha dichroa)

Recording frequency: 190 (/2263) 8%.
Population estimate: 2 000.
Status: Uncommon breeding resident in the highveld and middleveld.
Habitat preference: Forest and wattle stands.



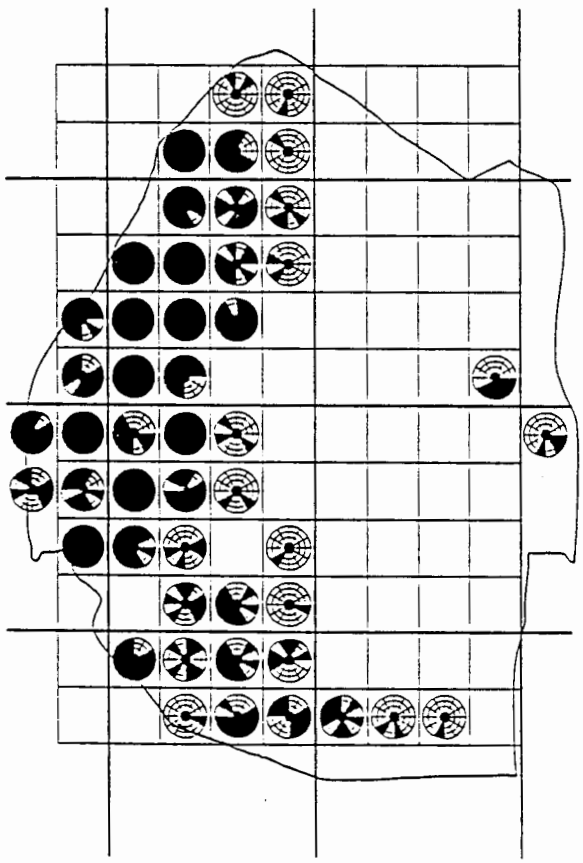
599. Heuglin's robin (Cossypha heuglini)

Recording frequency: 1 099 (/2263) 49%.
Population estimate: 20 000.
Status: Common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland.



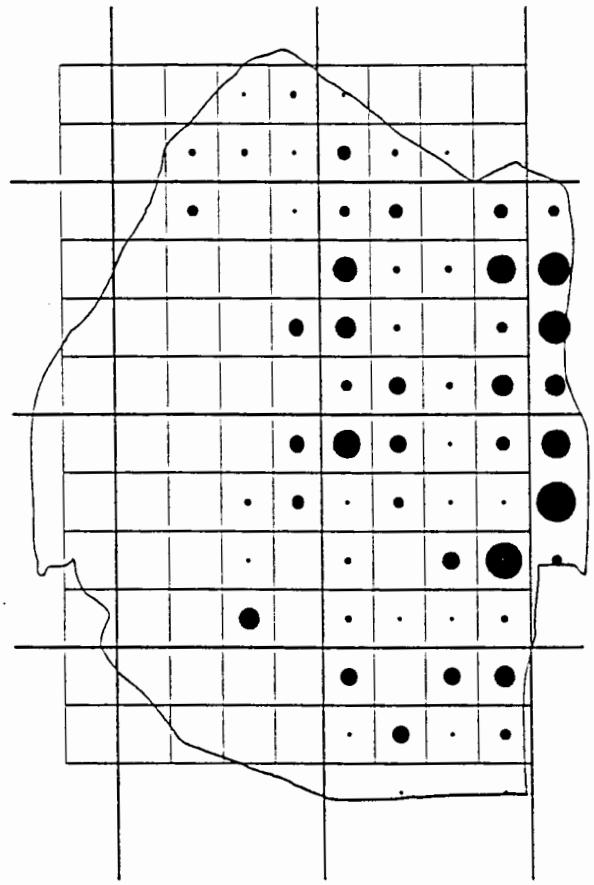
600. Natal robin. (Cossypha natalensis)

Recording frequency: 193 (/2263) 9%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland and forest.



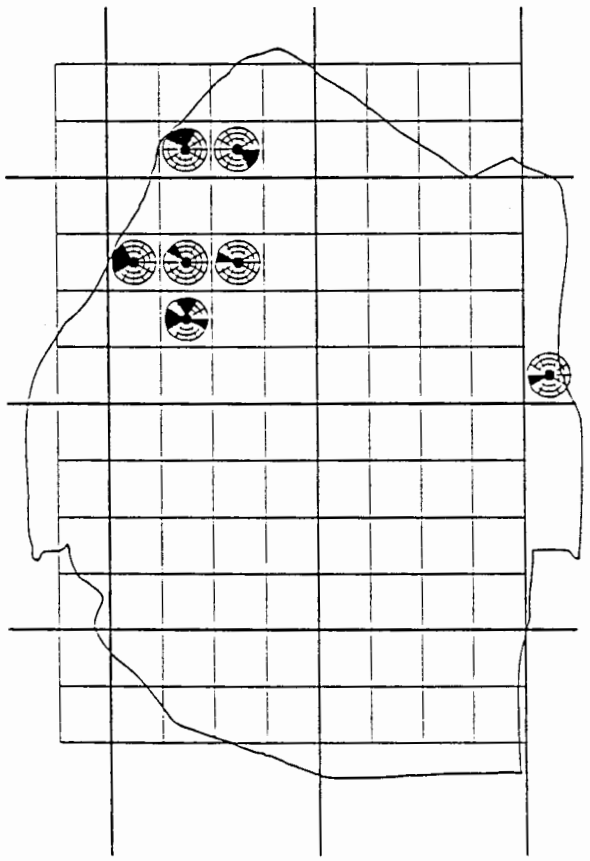
601. Cape robin. (Cossypha caffra)

Recording frequency: 537 (/2263) 24%.
Population estimate: 5 000.
Status: Common breeding resident in the highveld and middleveld and rare winter migrant to the highest part of the Lubombos.
Habitat preference: Woodland (including wattle stands and scrub-woodland among rocky outcrops).



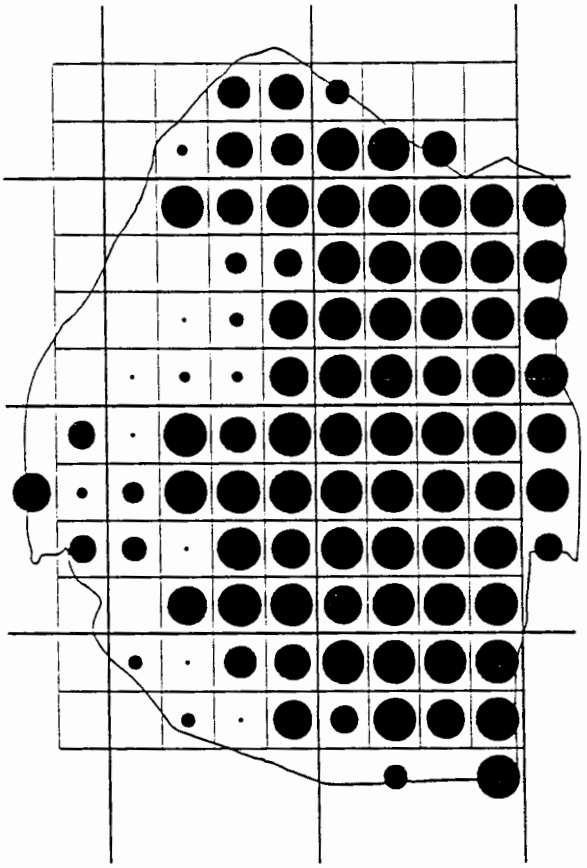
602. Whitethroated robin. (Cossypha humeralis)

Recording frequency: 244 (/2263) 11%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland.



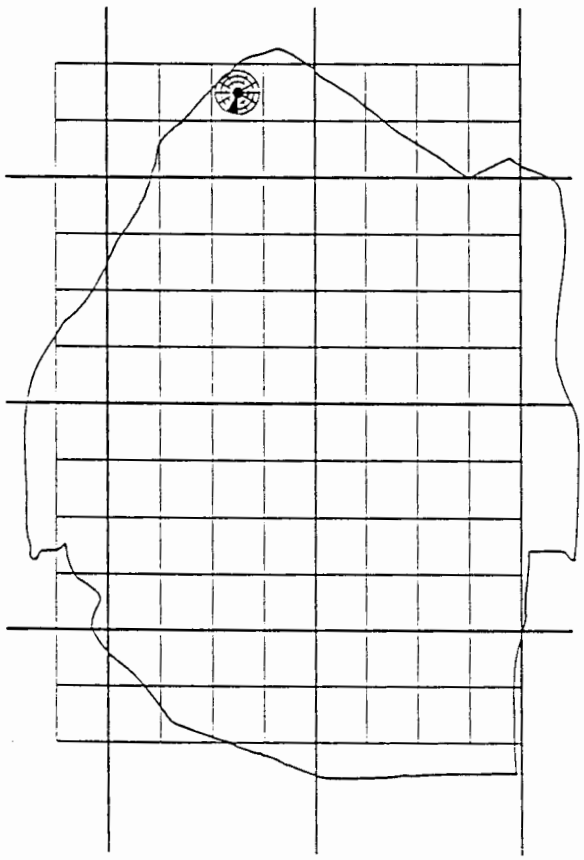
606. Starred robin. (Pogonocichla stellata)

Recording frequency: 18 (/2263) 1%.
Population estimate: 100.
Status: Uncommon breeding resident in the northern highveld and vagrant or rare visitor in the Lubombos. Not recorded in mid winter, but may be present then as it is very difficult to detect when not calling.
Habitat preference: Forest and wattle stands.



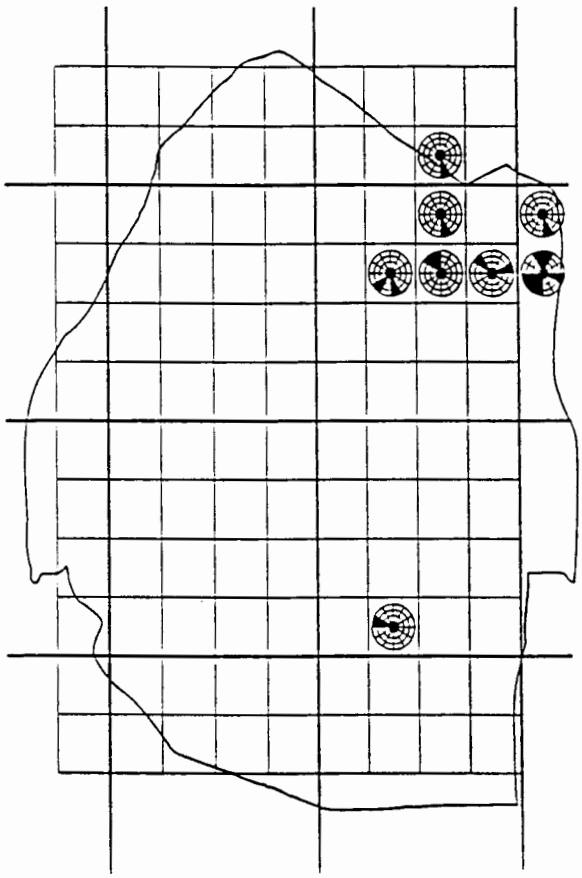
613. Whitebrowed robin. (Erythropygia leucophrys)

Recording frequency: 1 199 (/2263) 53%.
Population estimate: 70 000.
Status: Very common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Acacia woodland and savanna.



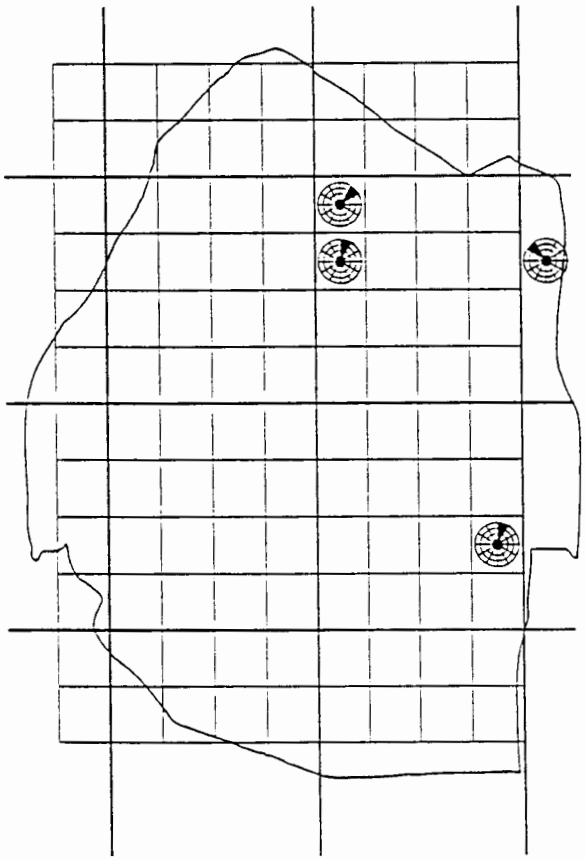
616. Brown robin. (Erythropygia signata)

Recording frequency: 1 (/2263) 0,05%.
Population estimate: 10.
Status: Possibly a breeding resident in the Mlumati Valley (A5).
Habitat preference: Forest.



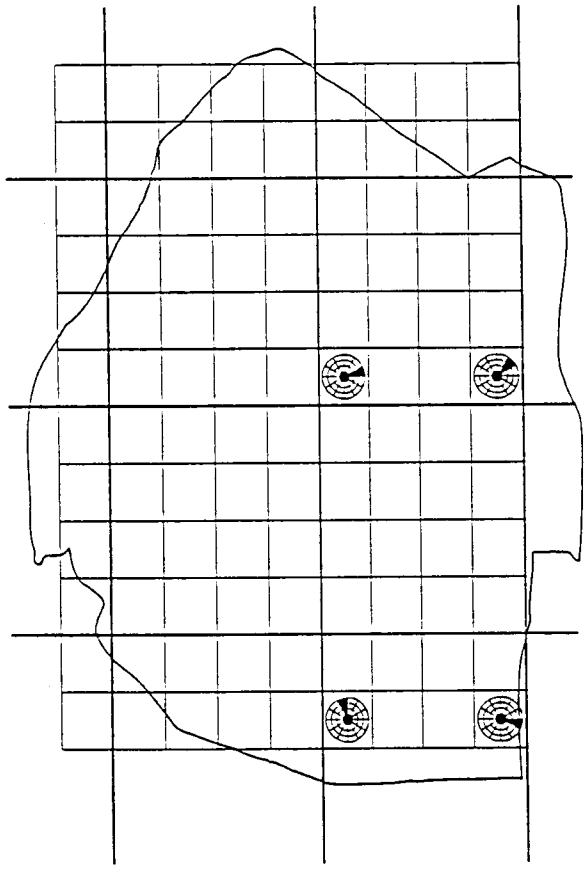
617. Bearded robin. (Erythropygia quadrivirgata)

Recording frequency: 15 (/2263) 1%.
Population estimate: 80.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Riverine woodland.



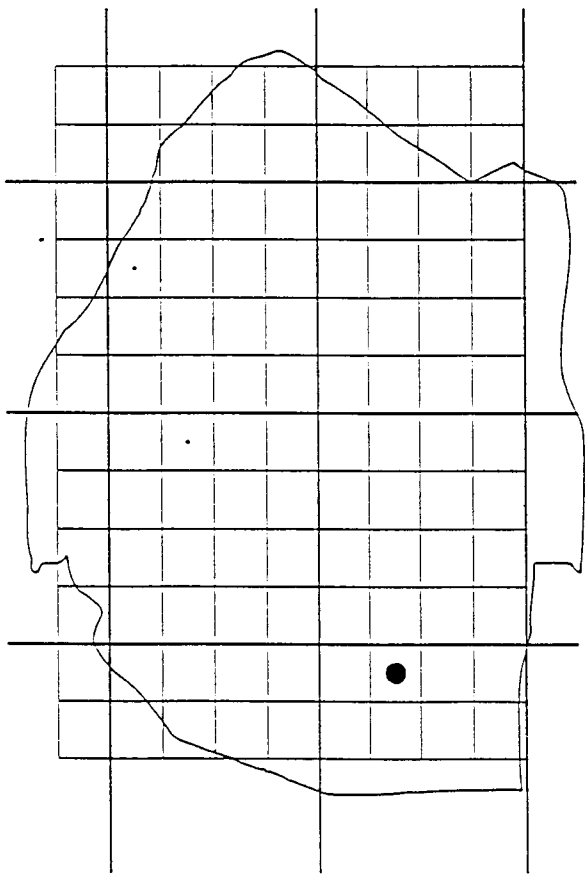
619. Garden warbler. (Sylvia borin)

Recording frequency: 4 (/2263) 0,20%.
Status: Rare summer migrant. Possibly more common and widespread than indicated as it is difficult to identify.
Habitat preference: Woodland and savanna.



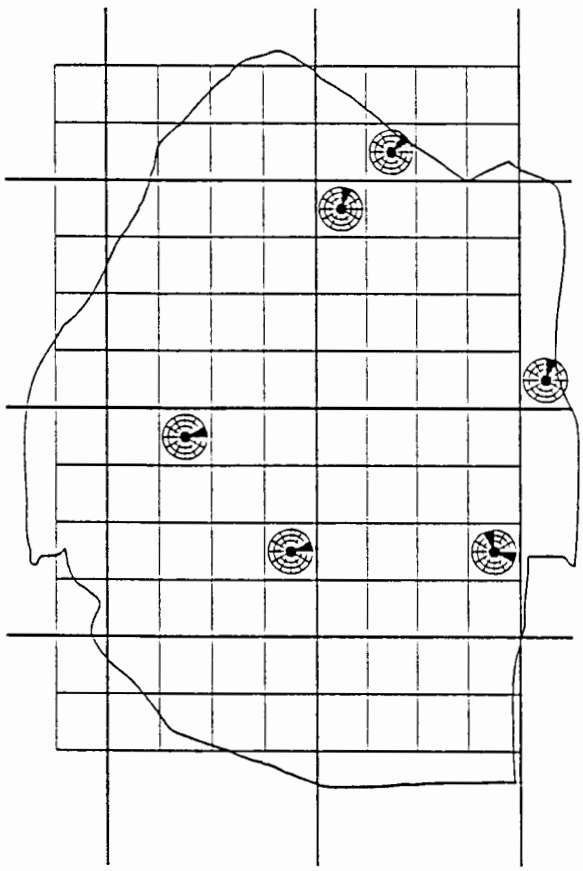
620. Whitethroat. (Sylvia communis)

Recording frequency: 4 (/2263) 0,20%.
Status: Rare summer migrant.
Habitat preference: Woodland and savanna.



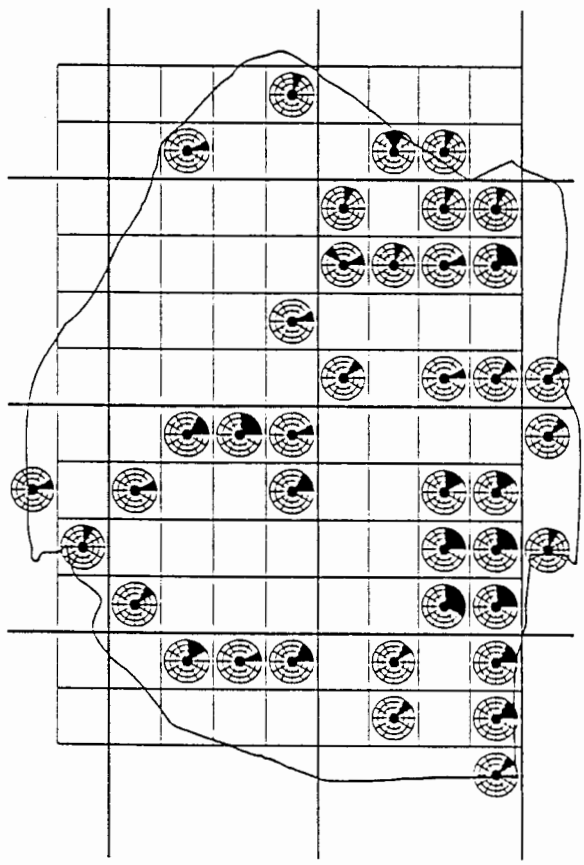
621. Titbabbler. (Parisoma subcaeruleum)

Recording frequency: 7 (/2263) 0,3%.
Population estimate: 20.
Status: A rare breeding resident in the vicinity of Maloma (K8) and a vagrant elsewhere.
Habitat preference: Acacia scrub woodland.



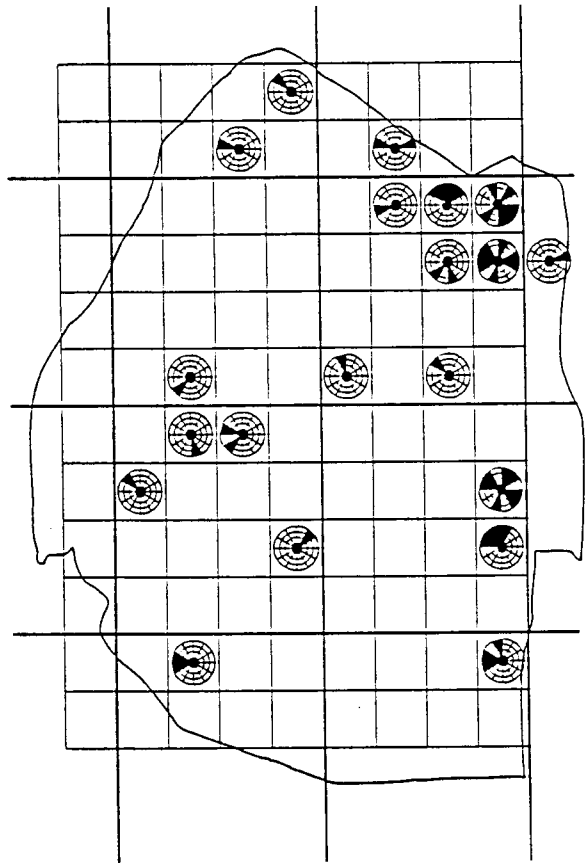
625. Icterine warbler. (Hippolais icterina)

Recording frequency: 7 (/2263) 0,35%.
Status: Rare summer migrant.
Habitat preference: Woodland.



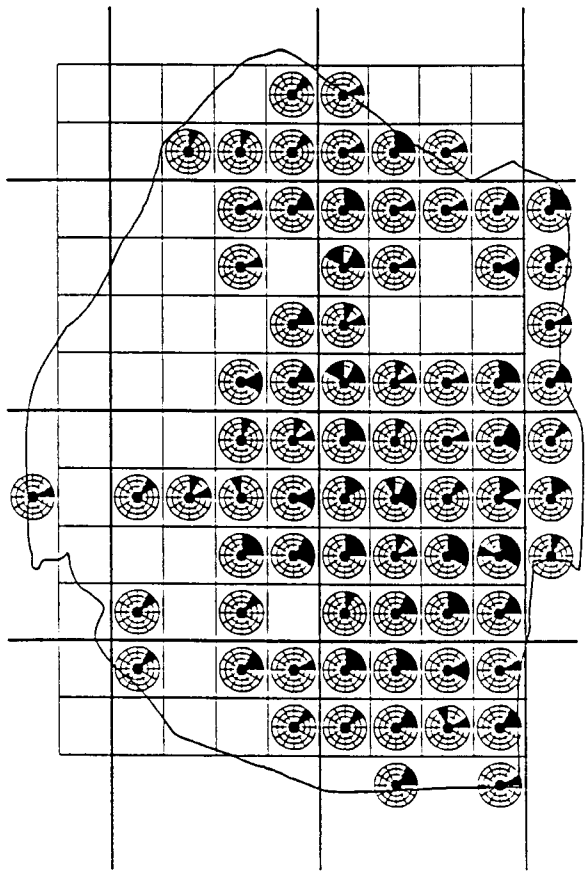
628. Great reed warbler. (Acrocephalus arundinaceus)

Recording frequency: 65 (/2263) 3%.
Status: Uncommon summer migrant in the southern highveld, middleveld, lowveld and Lubombos.
Habitat preference: Woodland (usually near rivers), riverbanks, reedbeds and vleis.



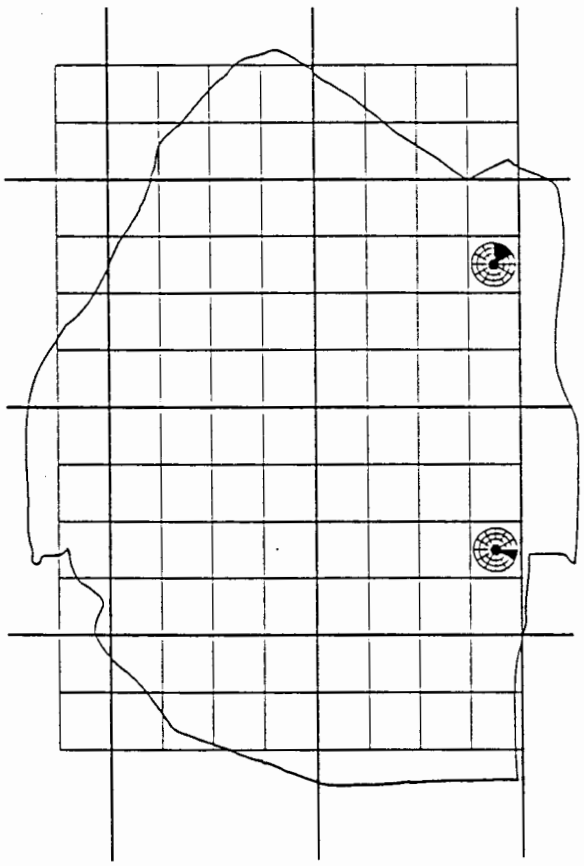
631. African marsh warbler. (Acrocephalus baeticatus)

Recording frequency: 55 (/2263) 2%.
Population estimate: 2 000.
Status: Uncommon breeding resident.
Habitat preference: Reedbeds and sugar cane fields.



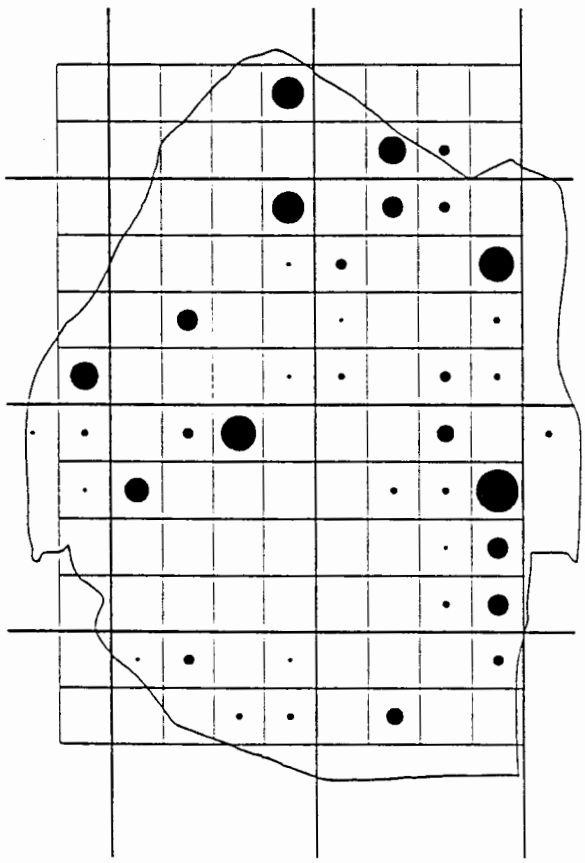
633. European marsh warbler. (Acrocephalus palustris)

Recording frequency: 142 (/2263) 6%.
Status: Common summer migrant in the middleveld, lowveld and Lubombos.
Habitat preference: Thickets in woodland.



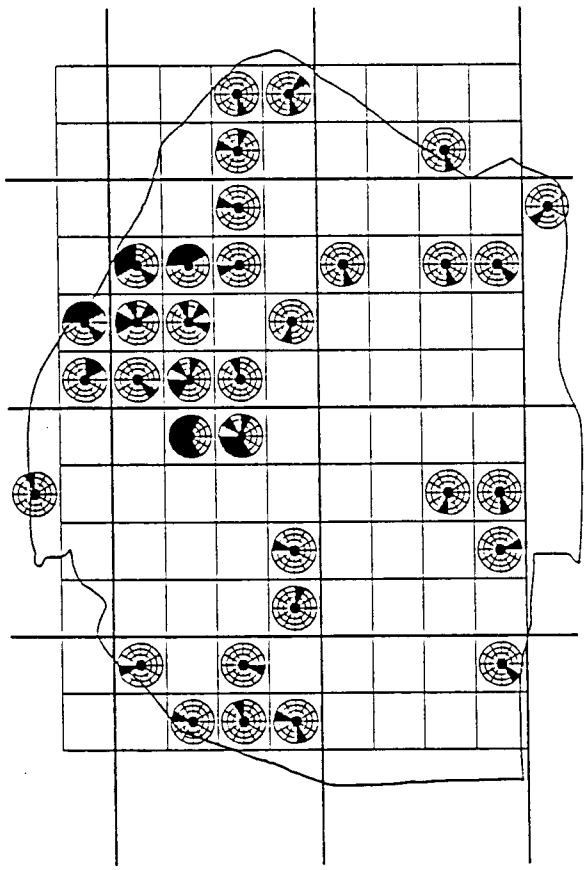
634. European sedge warbler. (Acrocephalus schoenobaenus)

Recording frequency: 3 (/2263) 0,15%.
Status: Rare summer migrant in the lowveld.
Habitat preference: Reedbeds and riverine thickets.
May be more common and widespread than indicated as it is difficult to identify.



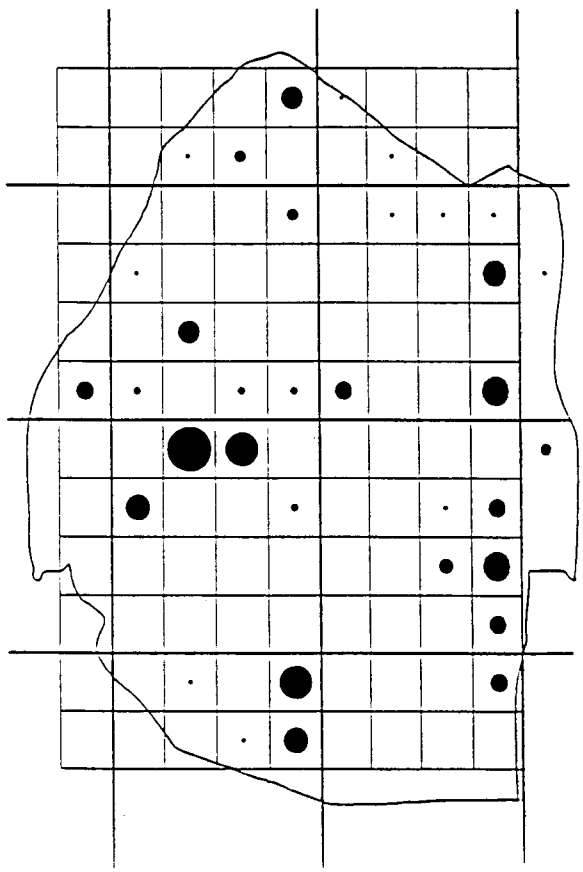
635. Cape reed warbler. (Acrocephalus gracilirostris)

Recording frequency: 172 (/2263) 8%.
Population estimate: 3 000.
Status: Uncommon breeding resident.
Habitat preference: Reedbeds.



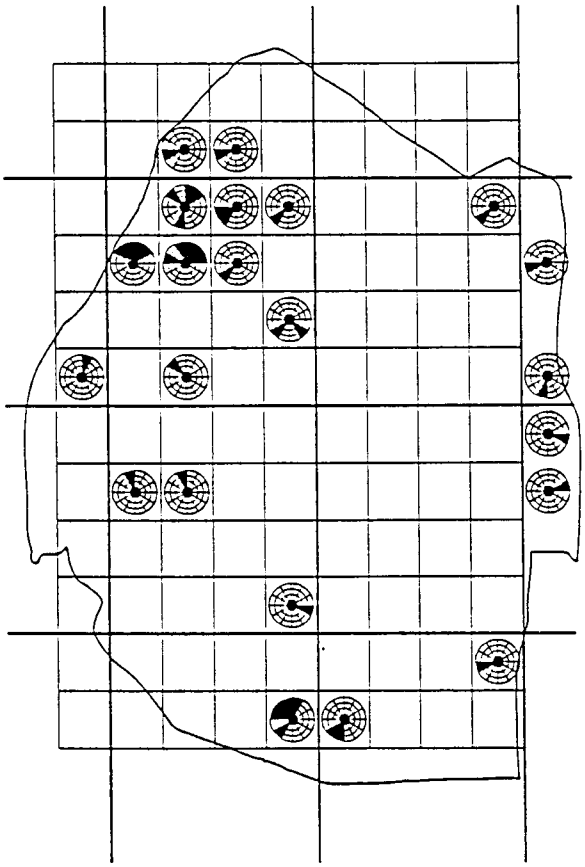
637. Yellow warbler. (Chloropeta natalensis)

Recording frequency: 85 (/2263) 4%.
Population estimate: 600.
Status: Uncommon breeding resident.
Habitat preference: Woodland, riverbanks, reedbeds and vleis.



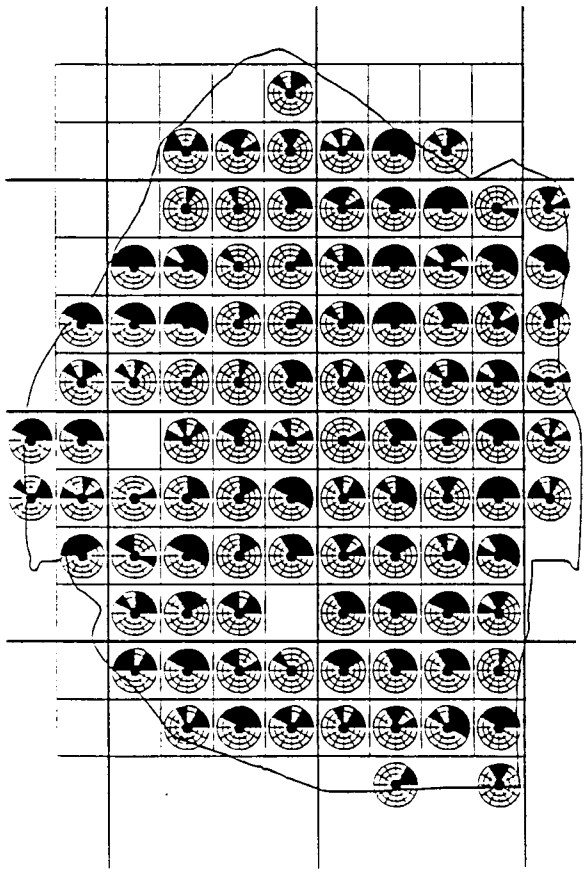
638. African sedge warbler. (Bradypterus baboecala)

Recording frequency: 150 (/2263) 7%.
Population estimate: 3 000.
Status: Uncommon breeding resident.
Habitat preference: Reedbeds.



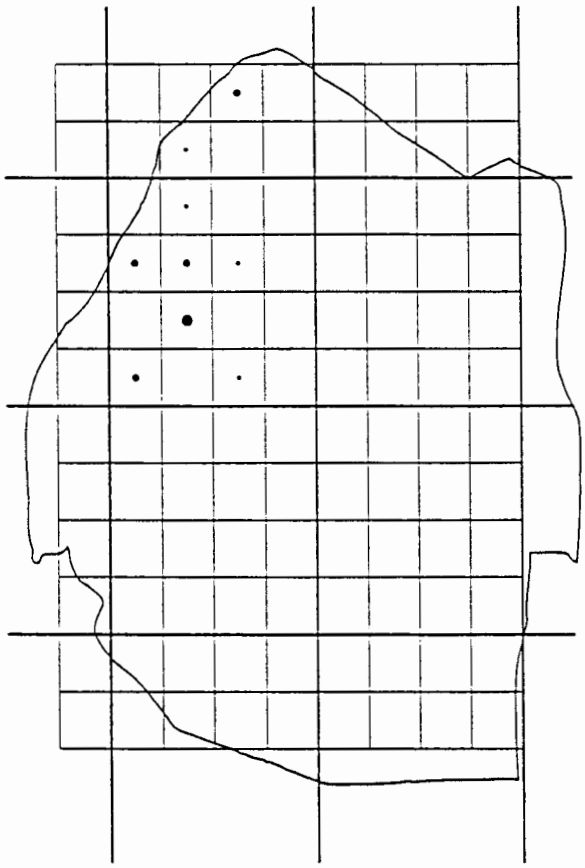
642. Broadtailed warbler. (Schoenicola brevirostris)

Recording frequency: 44 (/2263) 2%.
Population estimate: 300.
Status: Uncommon breeding resident in the highveld and middleveld and uncommon visitor in the lowveld and Lubombos. Appears to move out of high lying areas in the winter.
Habitat preference: Vleis and river banks with rank grass.



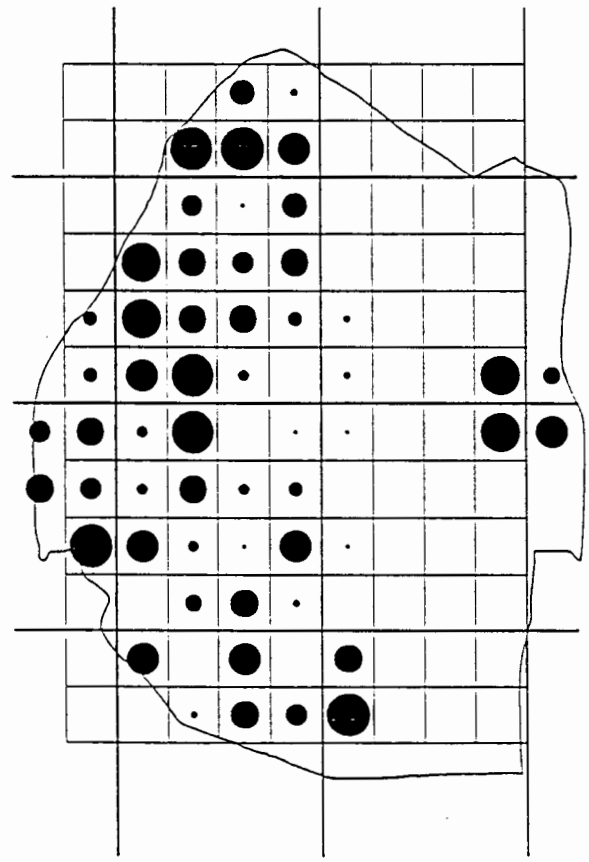
643. Willow warbler. (Phylloscopus trochilus)

Recording frequency: 402 (/2263) 18%.
Status: Common summer migrant.
Habitat preference: Forest, woodland and savanna.



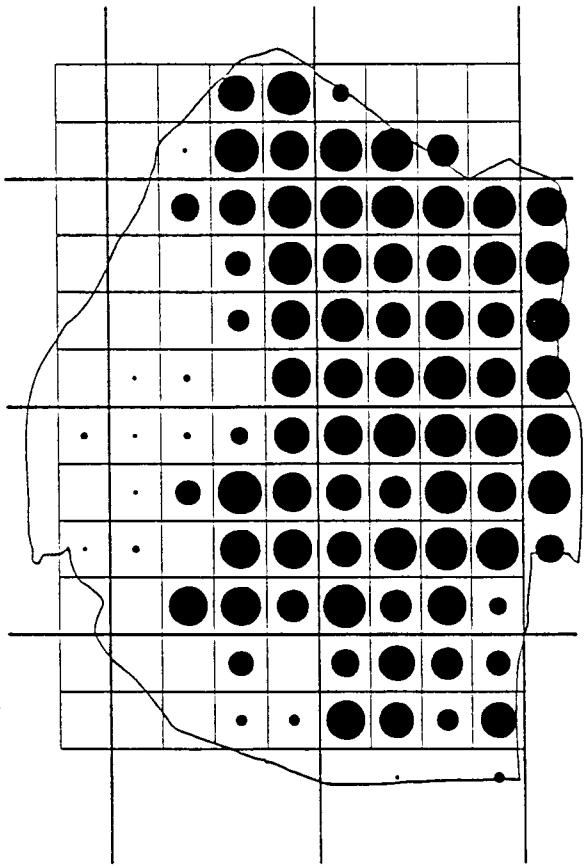
644. Yellowthroated warbler. (Seicercus ruficapillus)

Recording frequency: 15 (/2263) 1%.
Population estimate: 200.
Status: Uncommon breeding resident in the northern highveld.
Habitat preference: Forest.



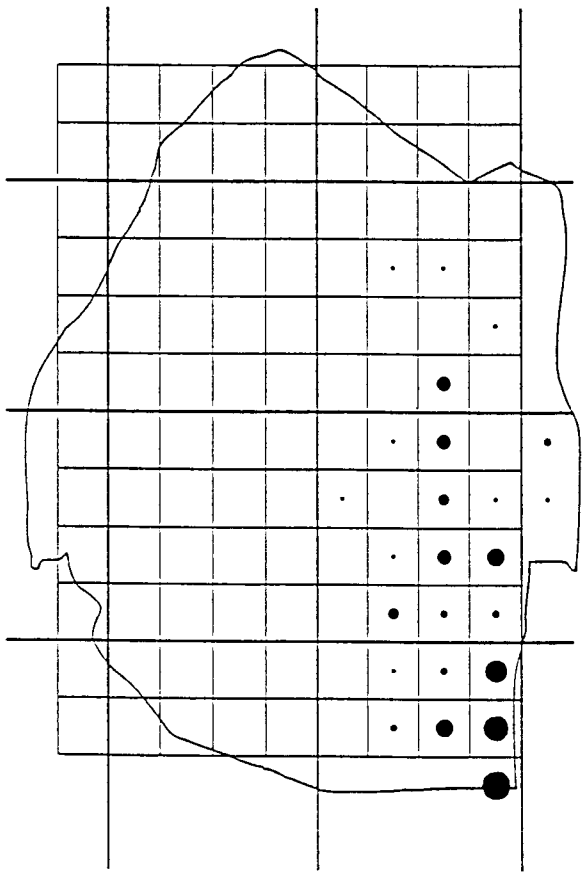
645. Barthroated apalis. (Apalis thoracica)

Recording frequency: 480 (/2263) 21%.
Population estimate: 20 000.
Status: Common breeding resident in the highveld, middleveld and the highest part of the Lubombos.
Habitat preference: Forest and woodland (including wattle stands).



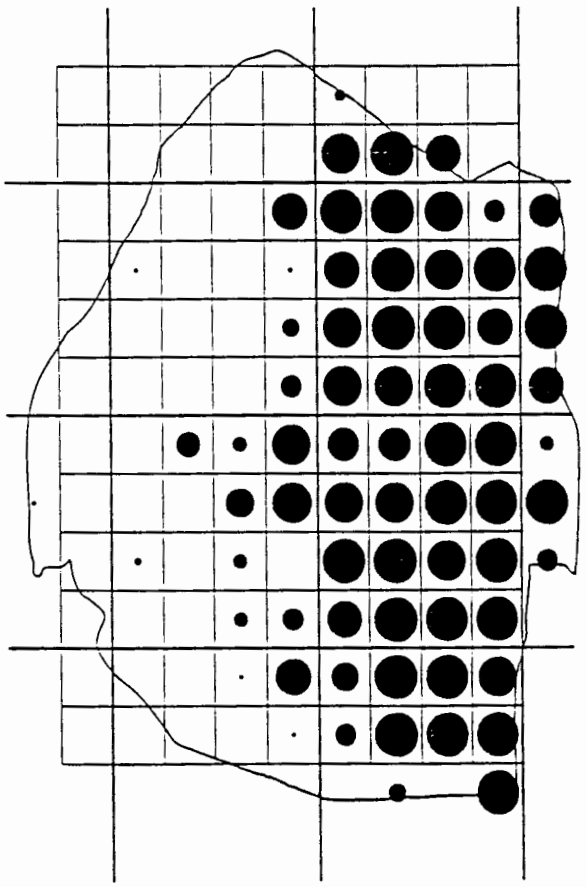
648. Yellowbreasted apalis. (Apalis flavida)

Recording frequency: 926 (/2263) 41%.
Population estimate: 50 000.
Status: Common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland and savanna.



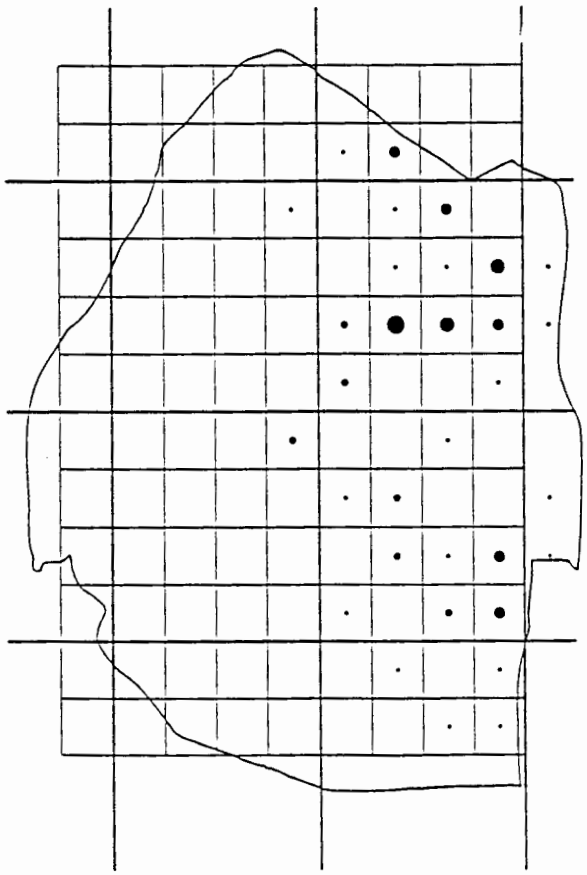
649. Rudd's apalis. (Apalis ruddi)

Recording frequency: 70 (/2263) 3%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the southern lowveld.
Habitat preference: Found in thickets in an acacia savanna environment.



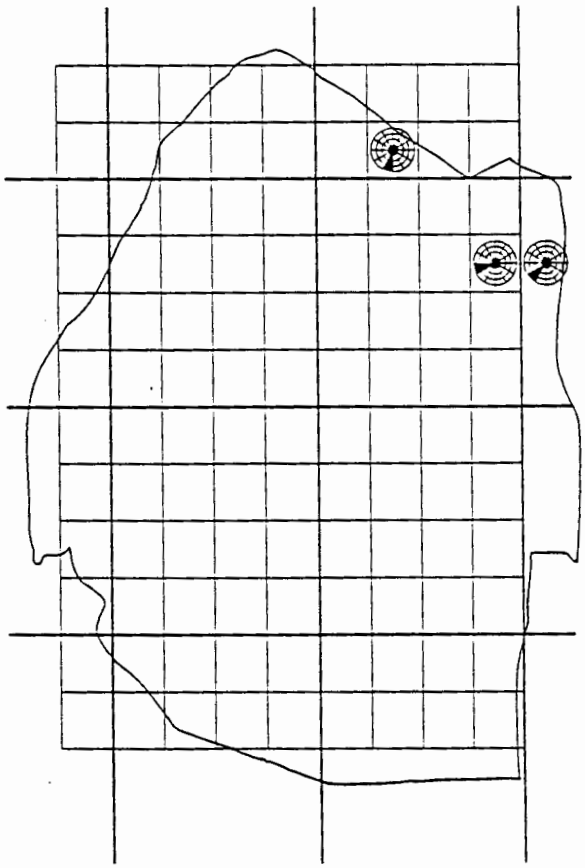
651. Longbilled crombec. (Sylvietta rufescens)

Recording frequency: 774 (/2263) 34%.
Population estimate: 30 000.
Status: Common breeding resident in the lowveld and Lubombos and vagrant in the middleveld and highveld.
Habitat preference: Acacia woodland and savanna.



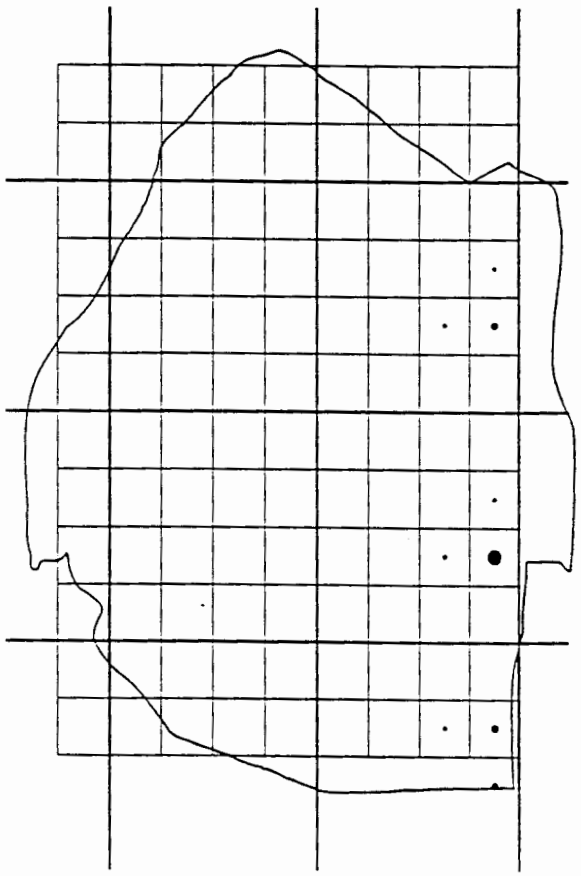
653. Yellowbellied eremomela. (Eremomela icteropygialis)

Recording frequency: 60 (/2263) 3%.
Population estimate: 600.
Status: Uncommon breeding resident in the lowveld and Lubombos.
Habitat preference: Acacia woodland and savanna.



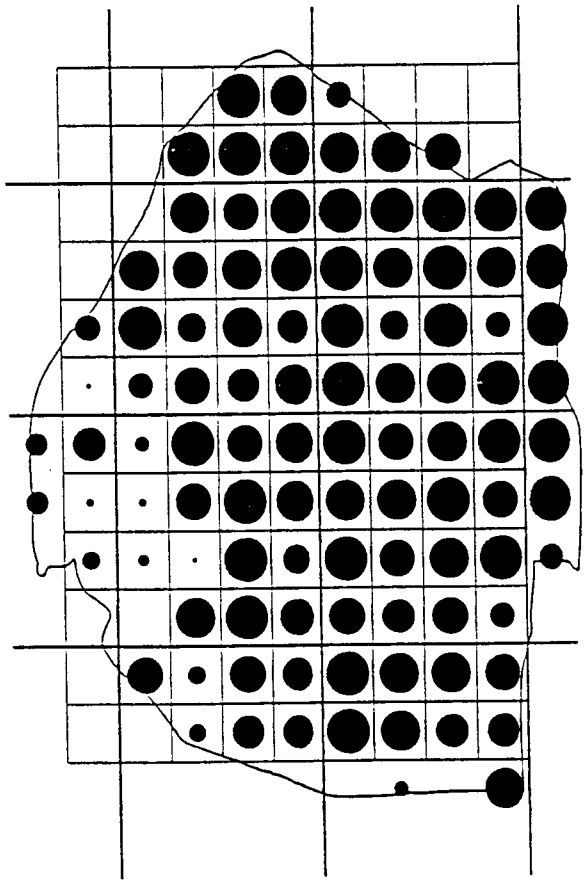
655. Greencapped eremomela. (Eremomela scotops)

Recording frequency: 3 (/2263) 0,15%.
Status: Rare visitor in the northern lowveld.
Habitat preference: Acacia woodland.



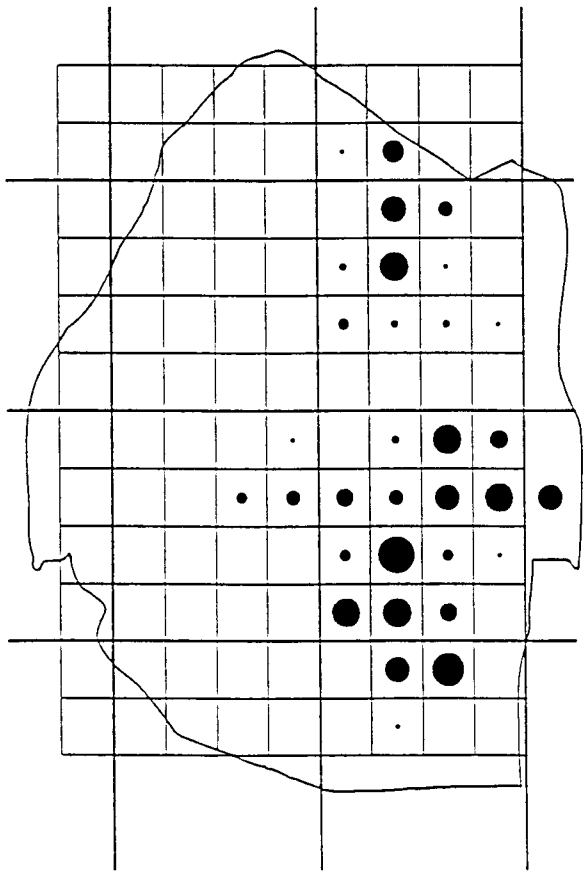
656. Burntnecked eremomela. (Eremomela usticollis)

Recording frequency: 16 (/2263) 1%.
Population estimate: 100.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Acacia woodland and savanna.



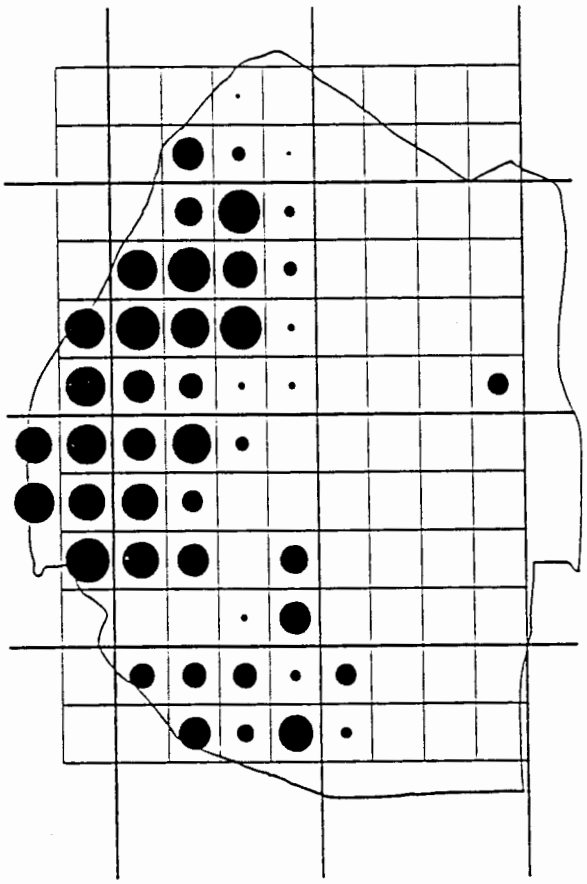
657. Bleating warbler. (Camaroptera brachyura)

Recording frequency: 1 304 (/2263) 58%.
Population estimate: 100 000.
Status: Very common breeding resident in most areas but uncommon in the southern highveld.
Habitat preference: Forest and woodland (including wattle stands).



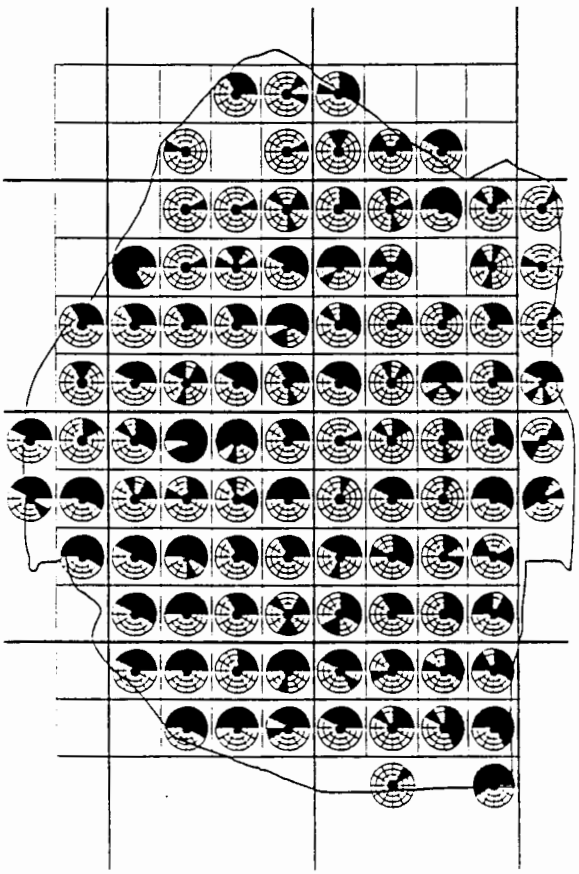
659. Stierling's barred warbler. (Camaroptera stierlingi)

Recording frequency: 159 (/2263) 7%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the lowveld, but absent from the more heavily wooded areas.
Habitat preference: Acacia woodland and savanna.



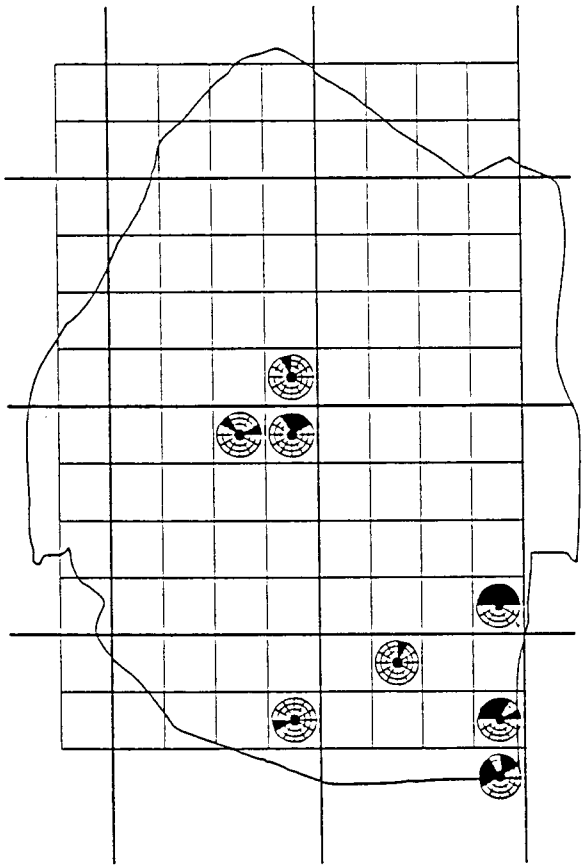
661. Grassbird. (Sphenoeacus afer)

Recording frequency: 429 (/2263) 19%.
Population estimate: 5 000.
Status: Common breeding resident in the highveld and middleveld and uncommon visitor to the highest part of the Lubombos.
Habitat preference: Grassland, vleis, broadleaved woodland and savanna with rank grass.



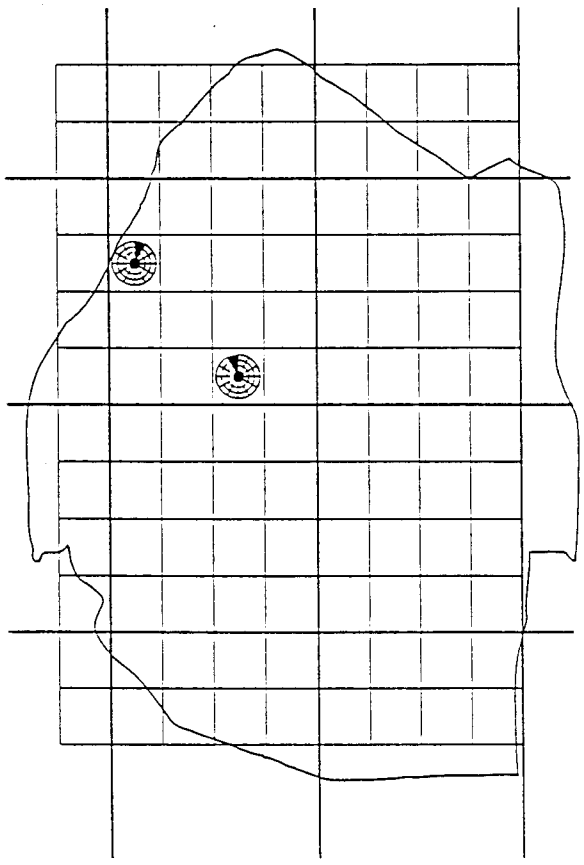
664. Fantailed cisticola. (Cisticola juncidis)

Recording frequency: 515 (/2263) 23%.
Population estimate: 200 000.
Status: Common breeding resident. The scarcity of winter records is due to the fact that it is very difficult to identify when not calling.
Habitat preference: Grassland and savanna.



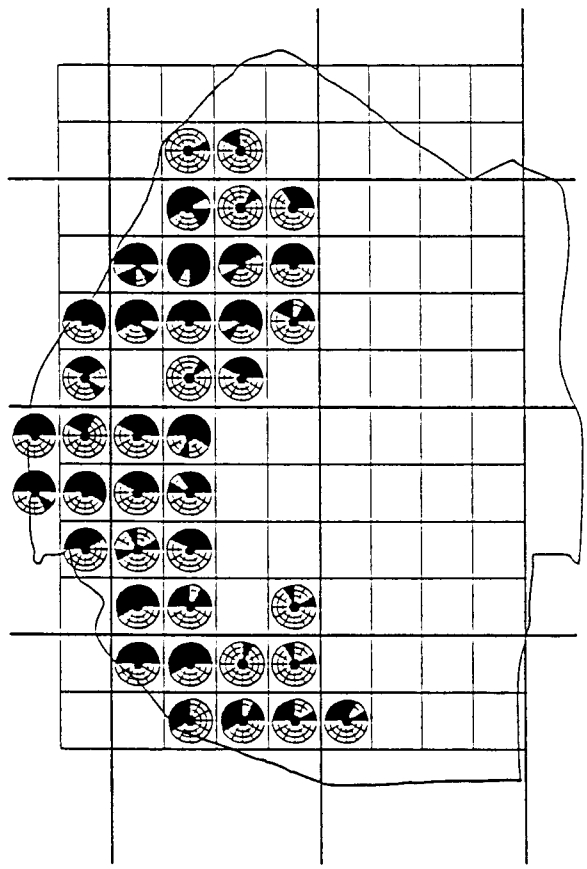
665. Desert cisticola. (Cisticola aridula)

Recording frequency: 24 (/2263) 1%.
Population estimate: 1 000.
Status: Uncommon breeding resident at a few localities in the southern lowveld and middleveld. The absence of winter records for the species is due to the fact that it is very difficult to identify when not calling.
Habitat preference: Grassland and savanna.



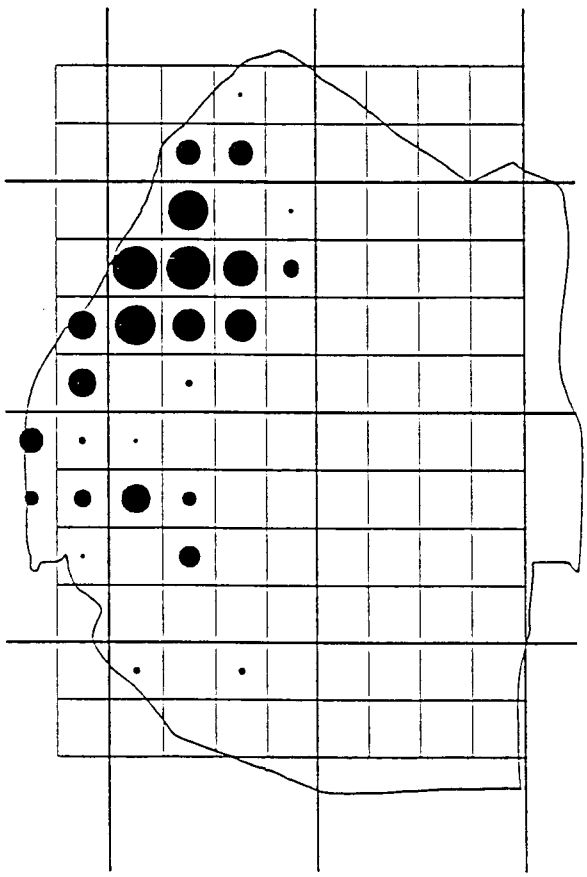
666. Cloud cisticola. (Cisticola textrix)

Recording frequency: 2 (/2263) 0,1%.
Status: Rare breeding resident in the highveld and middleveld.
Habitat preference: Grassland near vleis.



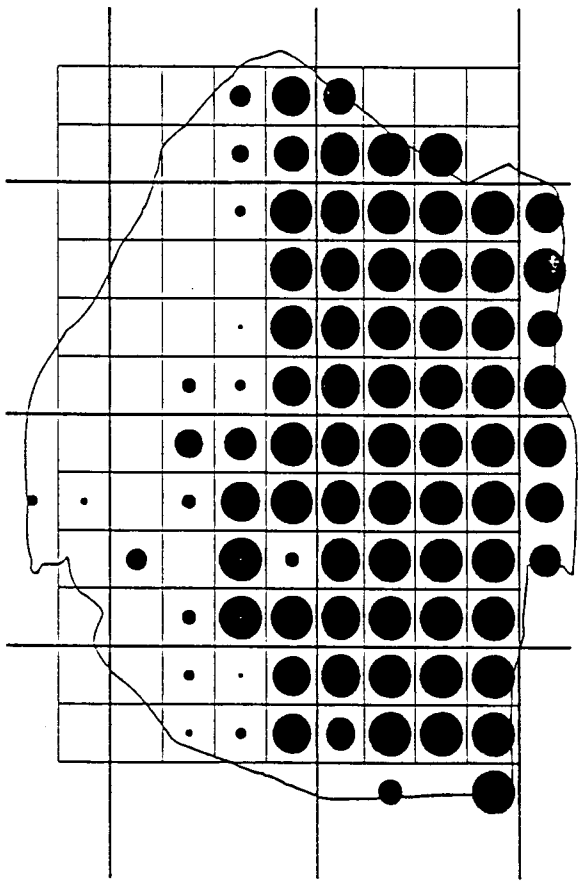
667. Ayres' cisticola. (Cisticola ayresii)

Recording frequency: 247 (/2263) 11%.
Population estimate: 100 000.
Status: Very common breeding resident in the highveld. The scarcity of winter records is due to the difficulty of identifying the species when it is not calling.
Habitat preference: Grassland.



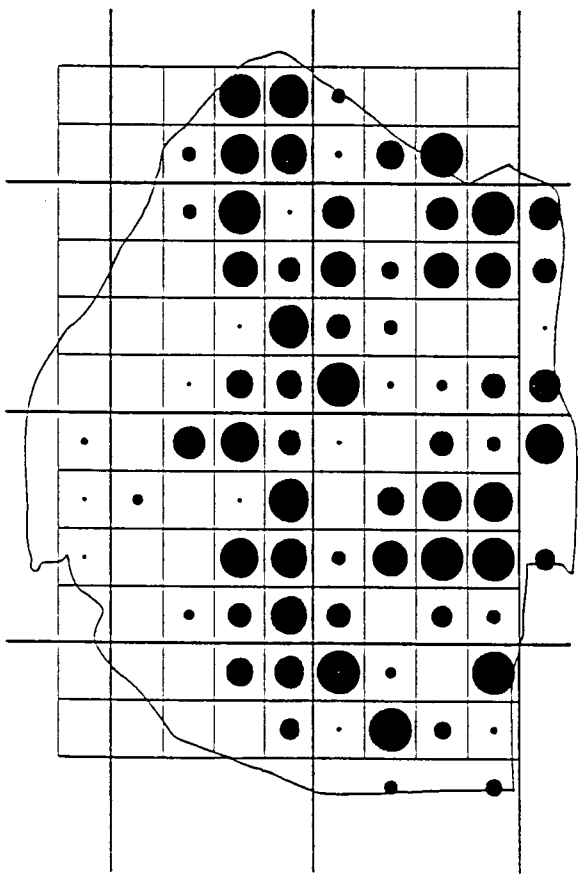
670. Wailing cisticola. (Cisticola lais)

Recording frequency: 206 (/2263) 9%.
Population estimate: 40 000.
Status: A breeding resident in the highveld, common in the north and uncommon in the south.
Habitat preference: Grassland (usually encountered on slopes).



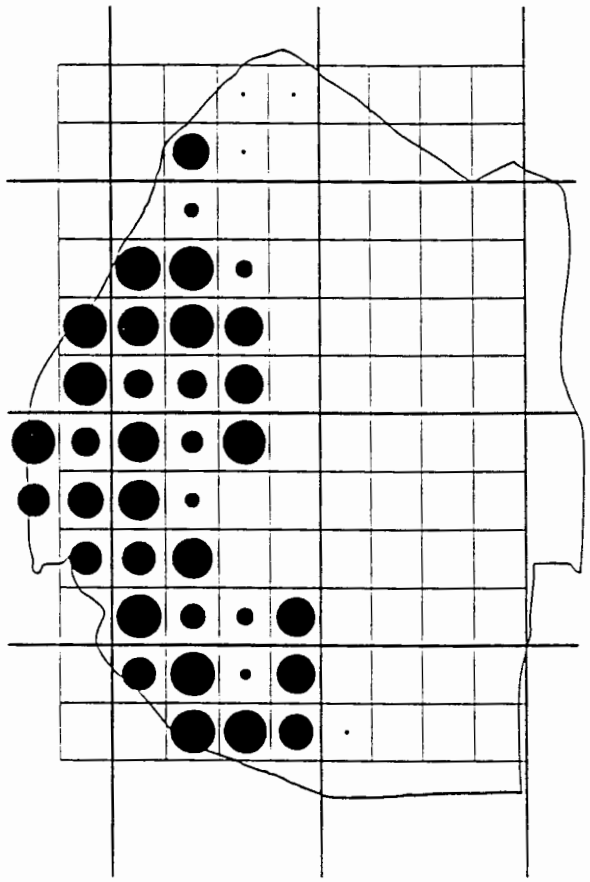
672. Rattling cisticola. (Cisticola chiniana)

Recording frequency: 1 091 (/2263) 48%.
Population estimate: 100 000.
Status: A breeding resident, very common in the lowveld and Lubombos and uncommon in the middleveld.
Habitat preference: Acacia woodland and savanna.



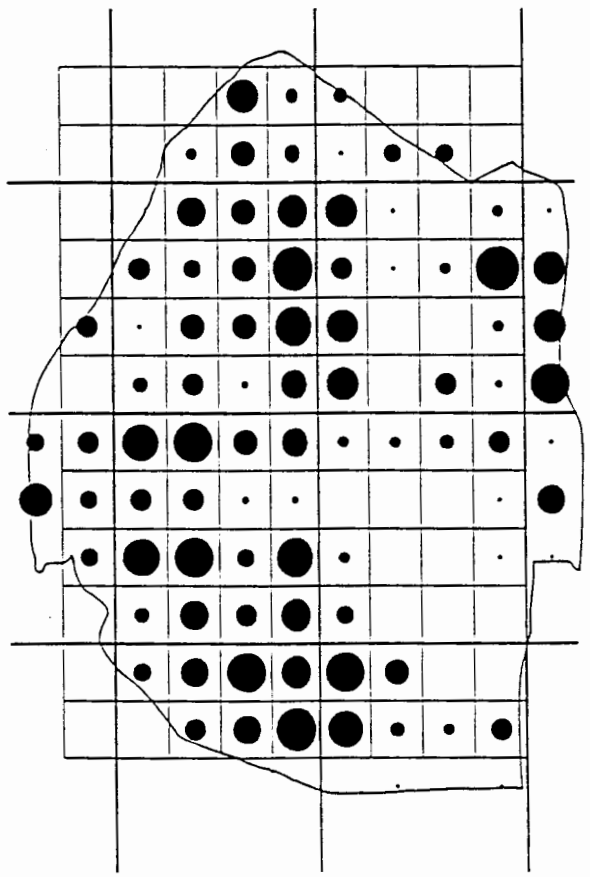
674. Redfaced cisticola. (Cisticola erythrops)

Recording frequency: 609 (/2263) 27%.
Population estimate: 40 000.
Status: Common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Riverbanks and vleis.



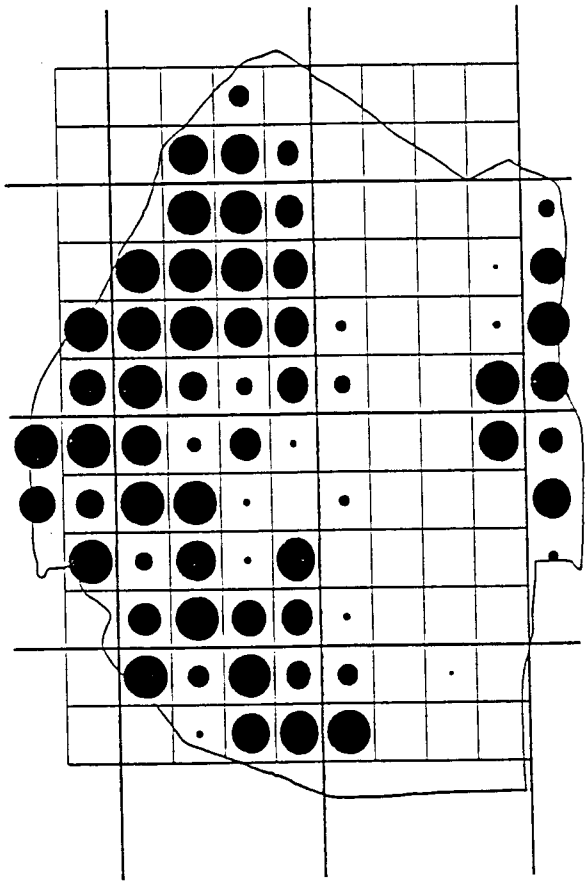
677. Levaillant's cisticola. (Cisticola tinniens)

Recording frequency: 470 (/2263) 21%.
Population estimate: 20 000.
Status: Common breeding resident in the highveld and middleveld.
Habitat preference: Reedbeds,vleis and rank vegetation near vleis.



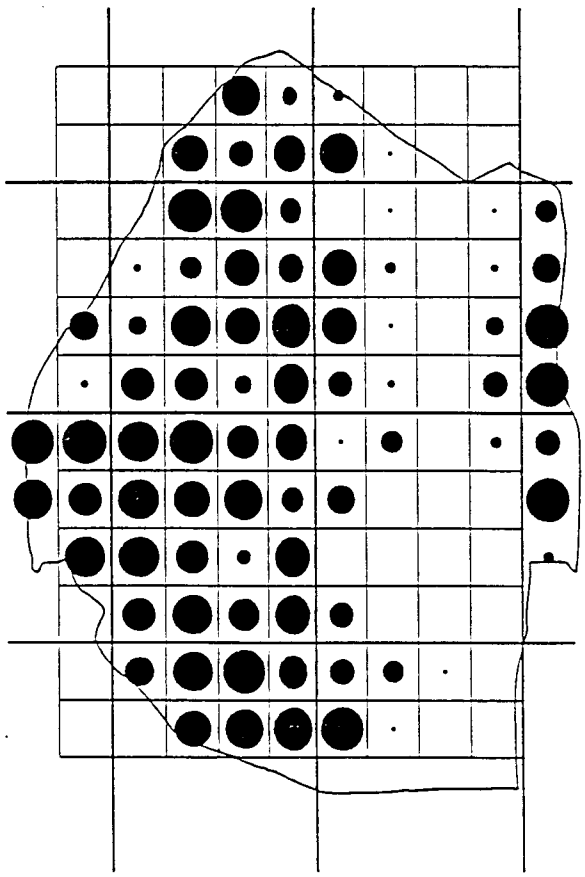
678. Croaking cisticola. (Cisticola natalensis)

Recording frequency: 588 (/2263) 26%.
Population estimate: 40 000.
Status: Common breeding resident in most areas but uncommon in the western and southern lowveld.
Habitat preference: Grassland and savanna.



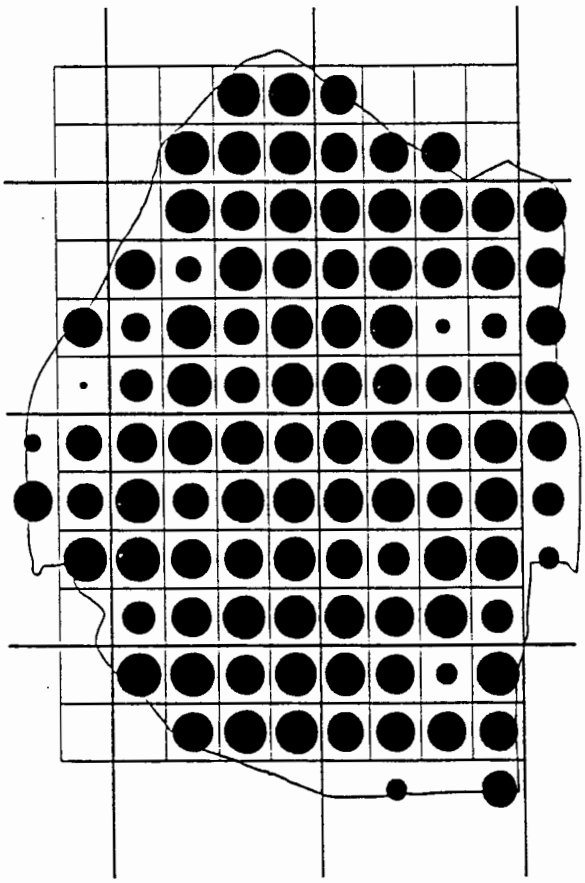
679. Lazy cisticola. (Cisticola aberrans)

Recording frequency: 729 (/2263) 32%.
Population estimate: 50 000.
Status: Common breeding resident in the highveld, middleveld and Lubombos.
Habitat preference: Usually associated with rocky hillsides, where it inhabits woodland, savanna and scrub woodland.



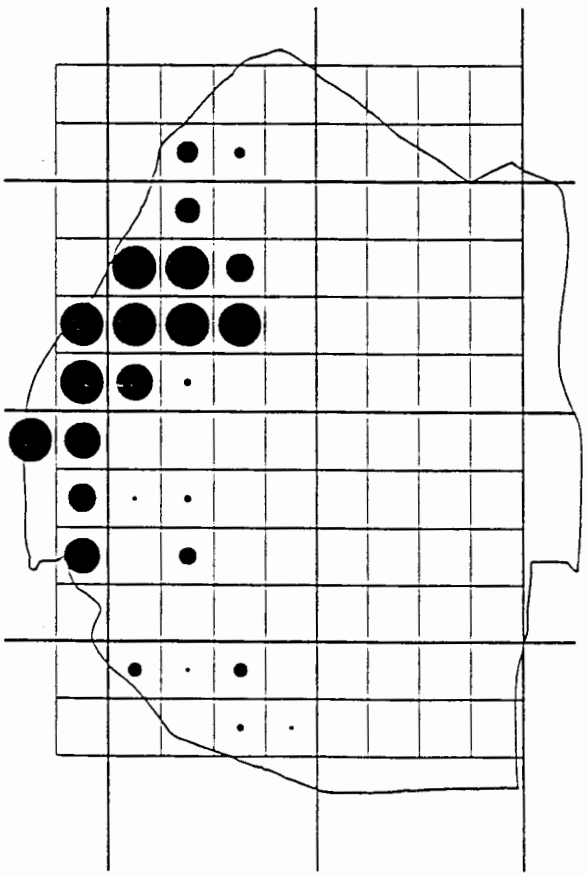
681. Nedicky. (Cisticola fulvicapilla)

Recording frequency: 726 (/2263) 32%.
Population estimate: 60 000.
Status: A common breeding resident, absent only from the flattest and lowest lying parts of the lowveld.
Habitat preference: Woodland and savanna, usually on stony, sloping ground.



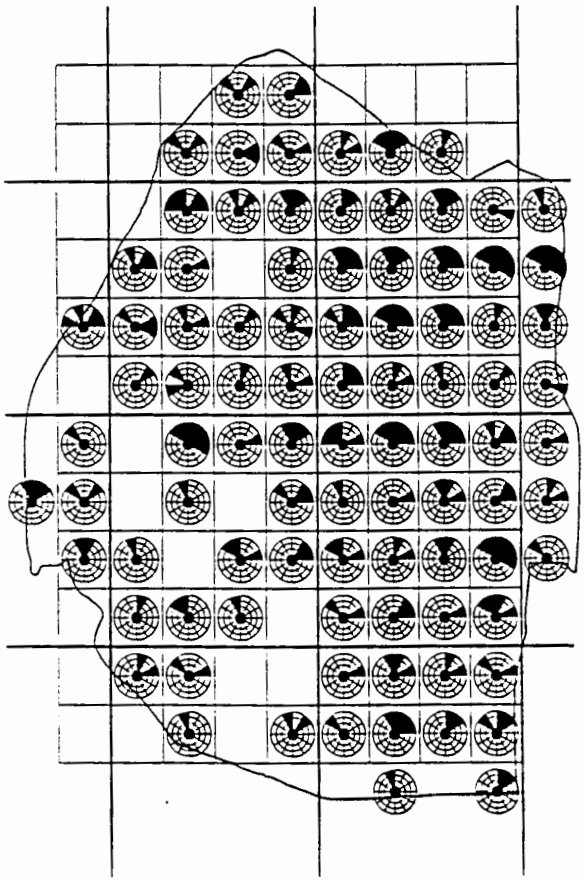
683. Tawnyflanked prinia. (Prinia subflava)

Recording frequency: 1 553 (/2263) 69%.
Population estimate: 500 000.
Status: Very common breeding resident.
Habitat preference: Vleis, savanna and woodland.



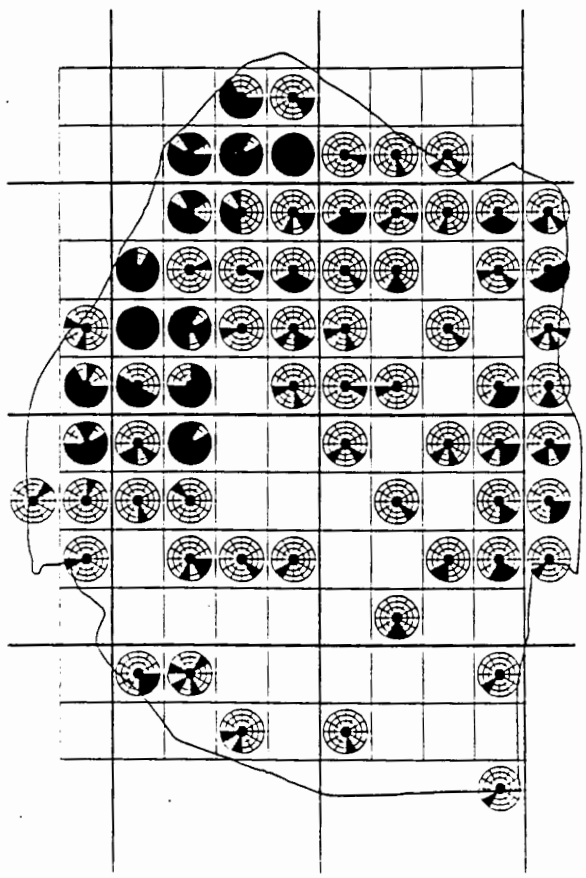
686. Spotted prinia. (Prinia maculosa)

Recording frequency: 258 (/2263) 11%.
Population estimate: 10 000.
Status: Common breeding resident in the highveld.
Habitat preference: Rank grass and scrub woodland.



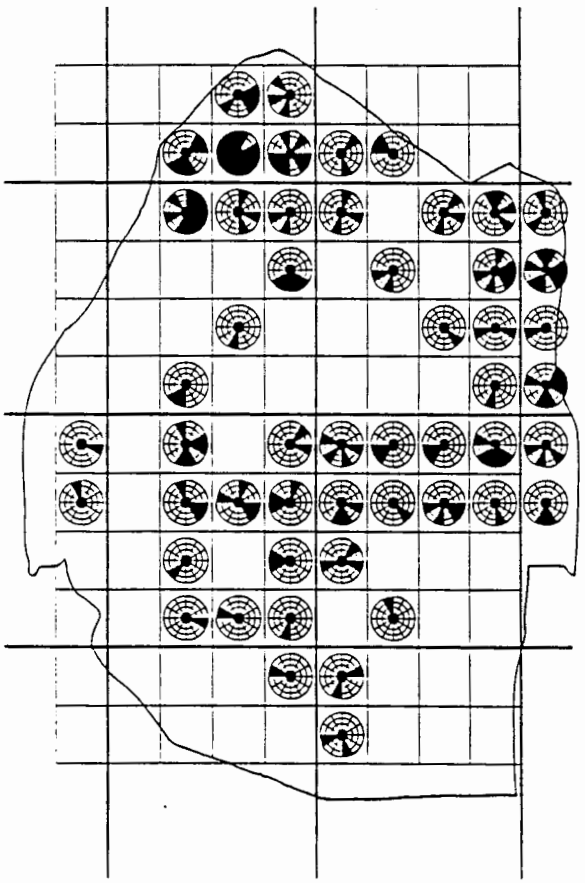
689. Spotted flycatcher. (Muscicapa striata)

Recording frequency: 248 (/2263) 11%.
Status: Common summer migrant.
Habitat preference: Woodland and savanna.



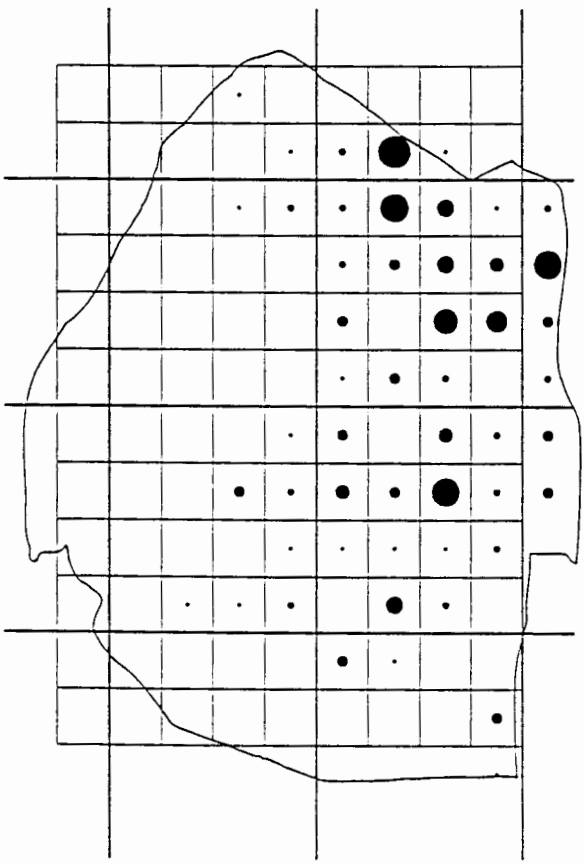
690. Dusky flycatcher. (Muscicapa adusta)

Recording frequency: 386 (/2263) 17%.
Population estimate: 4 000.
Status: A common breeding resident in the northern highveld, uncommon breeding resident in the southern highveld and middleveld and a common winter migrant to the lowveld and Lubombos. The highveld population does not appear to be depleted during the winter and the migratory birds presumably come from outside the borders of Swaziland.
Habitat preference: Forest and woodland (including wattle stands).



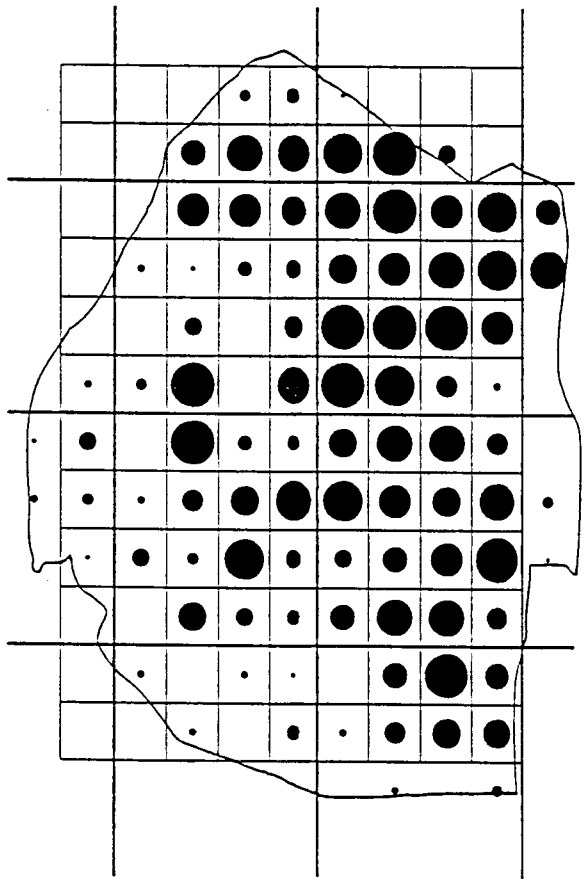
691. Bluegrey flycatcher. (Muscicapa caerulescens)

Recording frequency: 191 (/2263) 8%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos. May be seasonal in the central lowveld and Lubombos, where it has been recorded only in winter.
Habitat preference: Woodland.



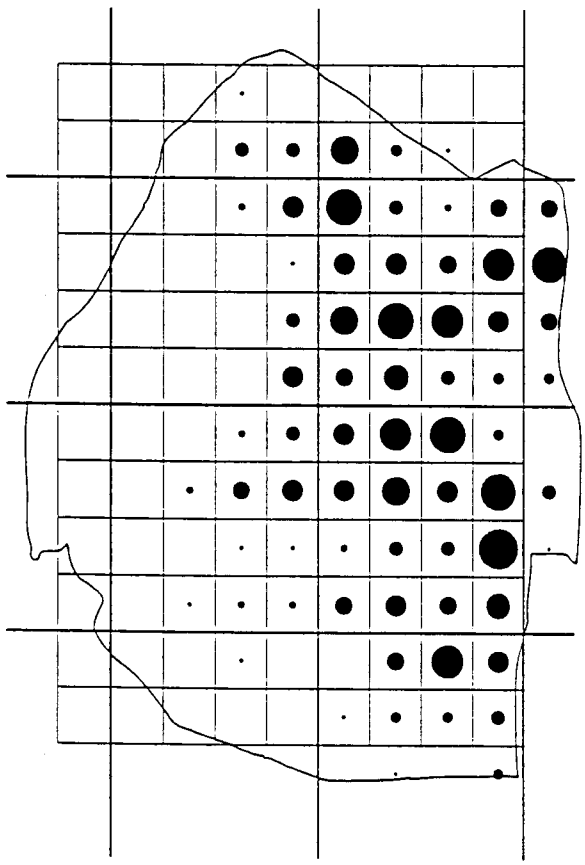
693. Fantailed flycatcher. (Myioparus plumbeus)

Recording frequency: 161 (/2263) 7%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland and savanna.



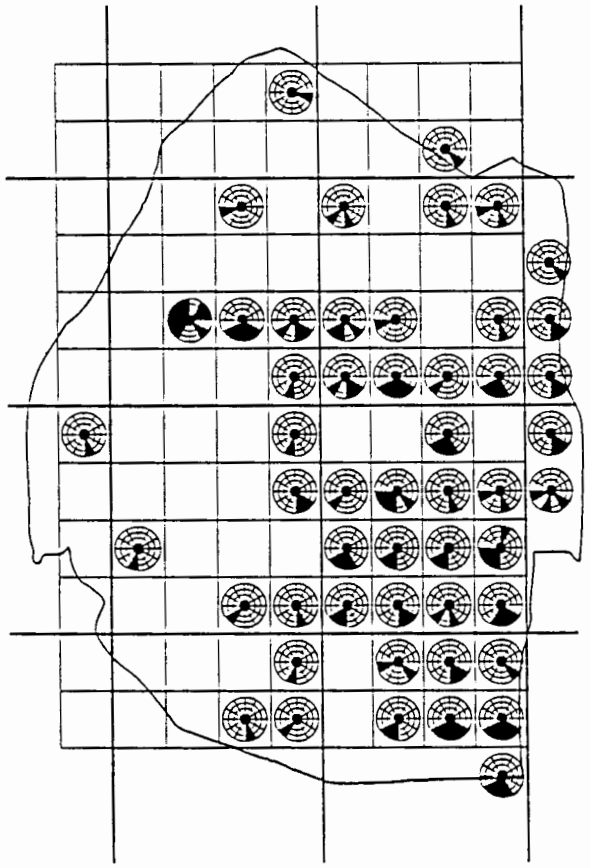
694. Black flycatcher. (Melaenornis pammelaina)

Recording frequency: 859 (/2263) 38%.
Population estimate: 10 000.
Status: A breeding resident, common in the lowveld and uncommon elsewhere.
Habitat preference: Woodland and savanna.



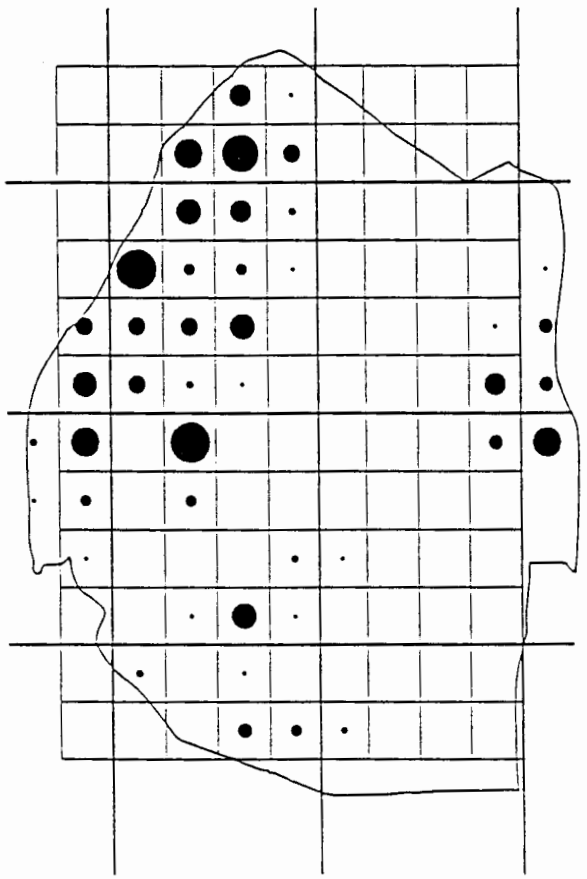
696. Pallid flycatcher. (Melaenornis pallidus)

Recording frequency: 373 (/2263) 16%.
Population estimate: 3 000.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland and savanna.



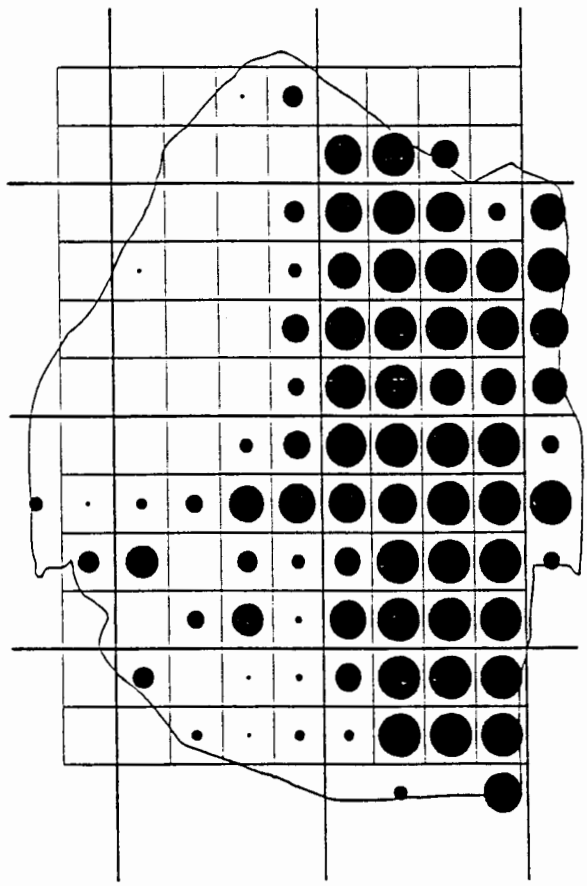
698. Fiscal flycatcher. (Sigelus silens)

Recording frequency: 111 (/2263) 5%.
Status: Uncommon winter migrant, rarely encountered in summer.
Habitat preference: Woodland and savanna.



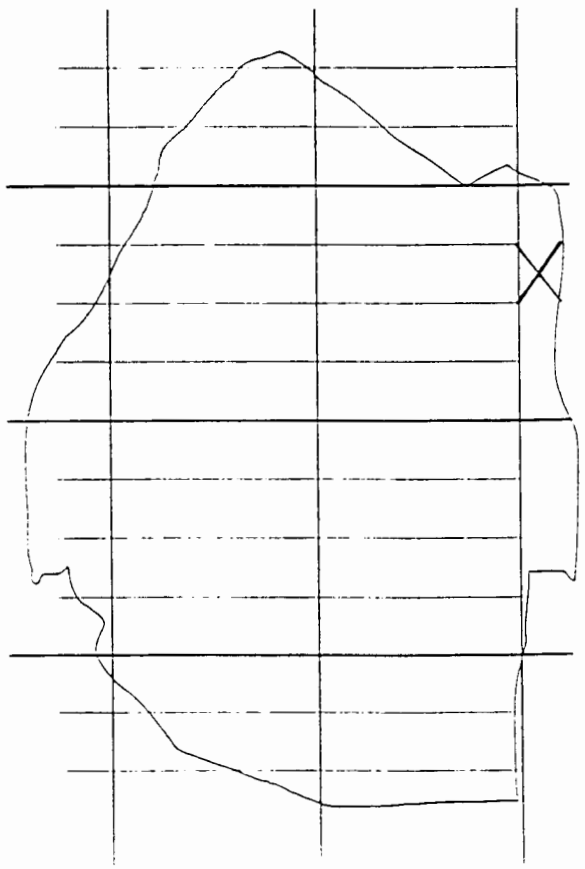
700. Cape batis. (Batis capensis)

Recording frequency: 218 (/2263) 10%.
Population estimate: 4 000.
Status: Uncommon breeding resident in the highveld, middleveld and higher parts of the Lubombos.
Habitat preference: Forest and wattle stands.



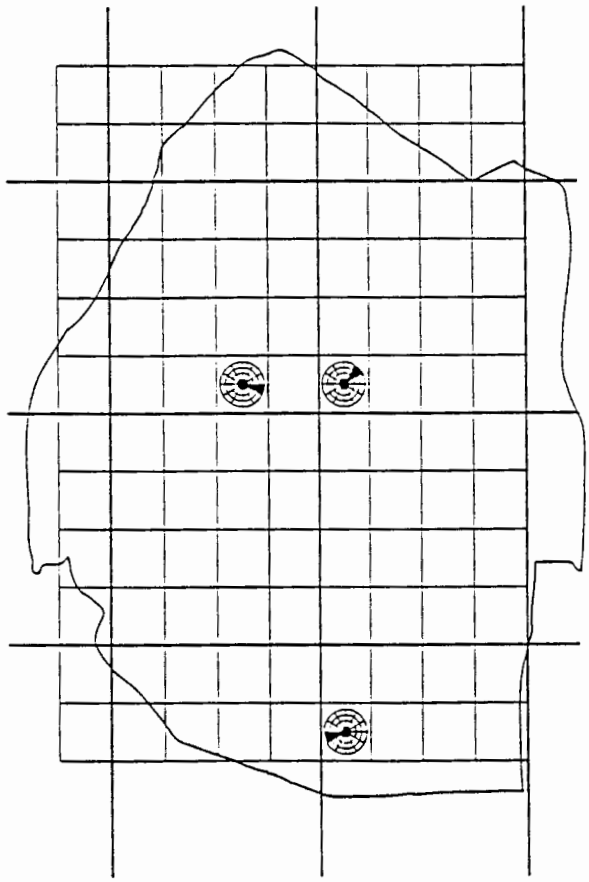
701. Chinspot batis. (Batis molitor)

Recording frequency: 885 (/2263) 39%.
Population estimate: 20 000.
Status: A breeding resident, very common in the lowveld and Lubombos and uncommon in the southern highveld and middleveld.
Habitat preference: Woodland and savanna.



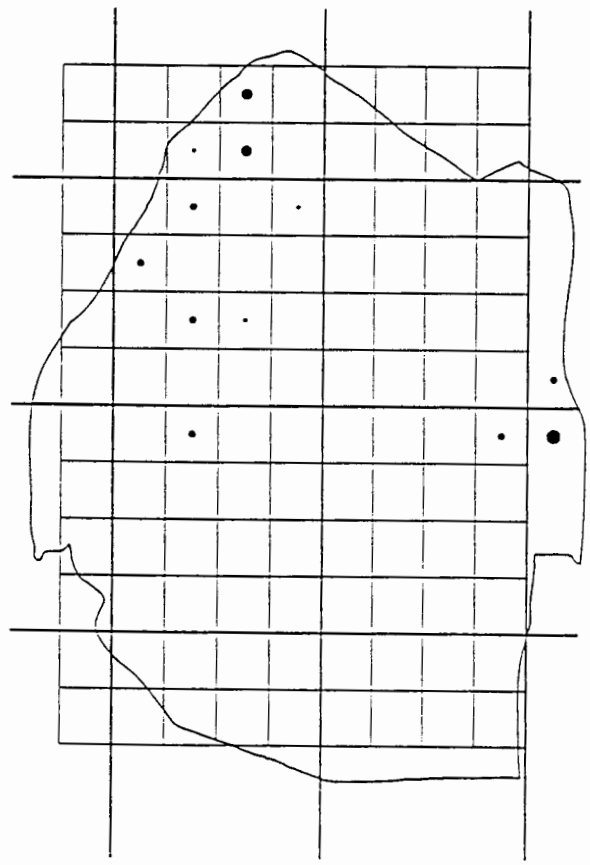
705. Wattle-eyed flycatcher. (Platysteira peltata)

A bird was seen in a forest in the Lubombos (D11) before 1985 (J. Culverwell).



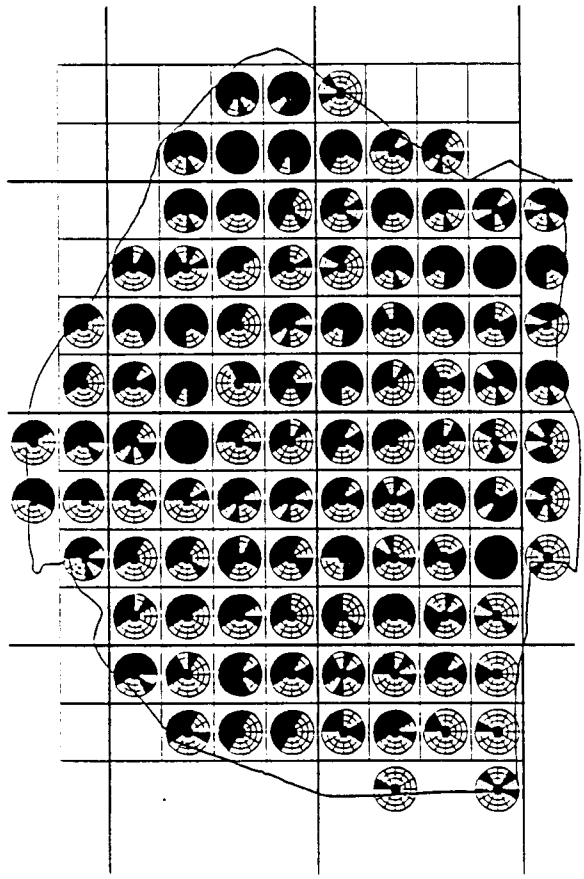
706. Fairy flycatcher. (Stenostira scita)

Single birds were seen at Kwaluseni (F5) in April 1988 (VP), at Mafutseni (F7) in February 1990 (M. Lourens) and at Hluti (L7) in September 1991 (VP).



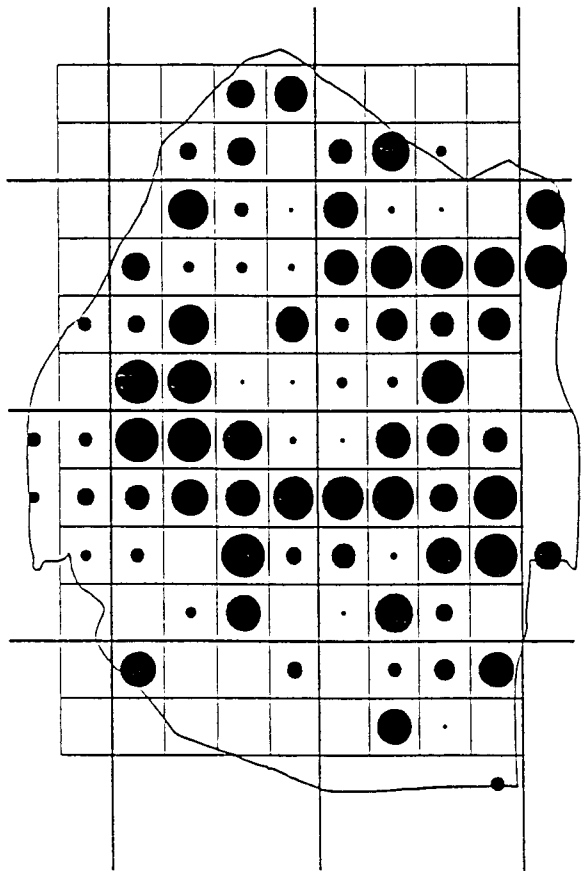
708. Bluemantled flycatcher. (Trochocercus cyanomelas)

Recording frequency: 27 (/2263) 1%.
Population estimate: 200.
Status: Uncommon breeding resident in the northern highveld and the highest part of the Lubombos.
Habitat preference: Forest.



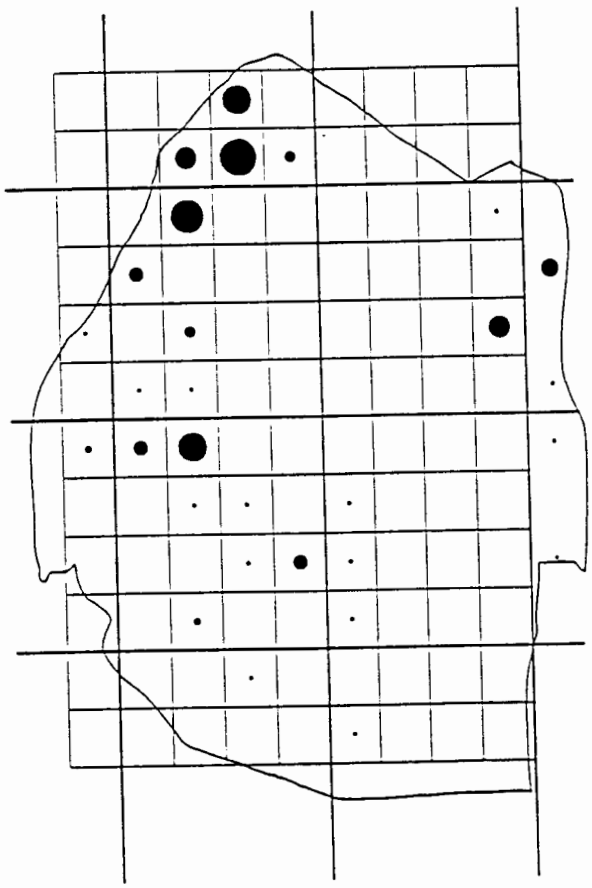
710. Paradise flycatcher. (Terpsiphone viridis)

Recording frequency: 1 096 (/2263) 48%.
Population estimate: 20 000.
Status: A common breeding resident, but encountered less often in winter and may therefore be a partial migrant.
Habitat preference: Woodland.



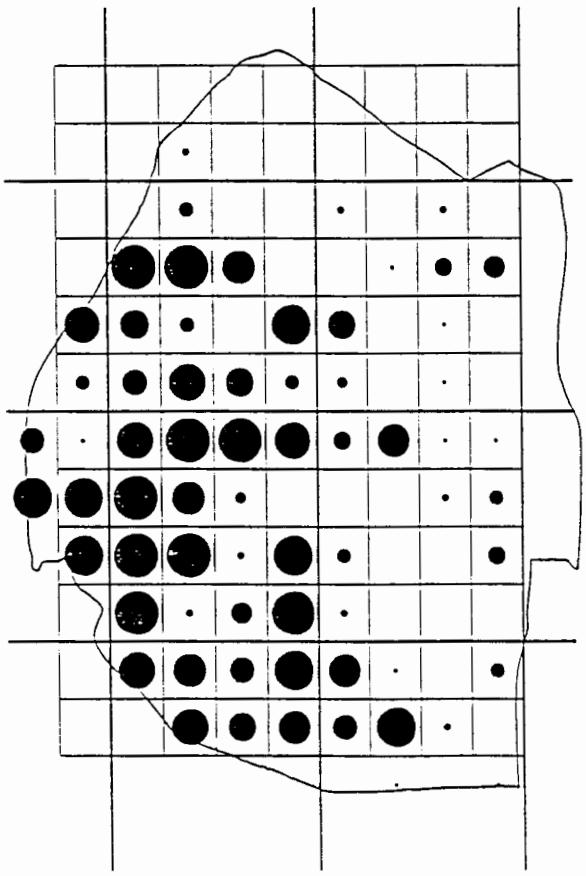
711. African pied wagtail. (Motacilla aguimp)

Recording frequency: 869 (/2263) 38%.
Population estimate: 1 000.
Status: Common breeding resident.
Habitat preference: Shores of rivers and dams.



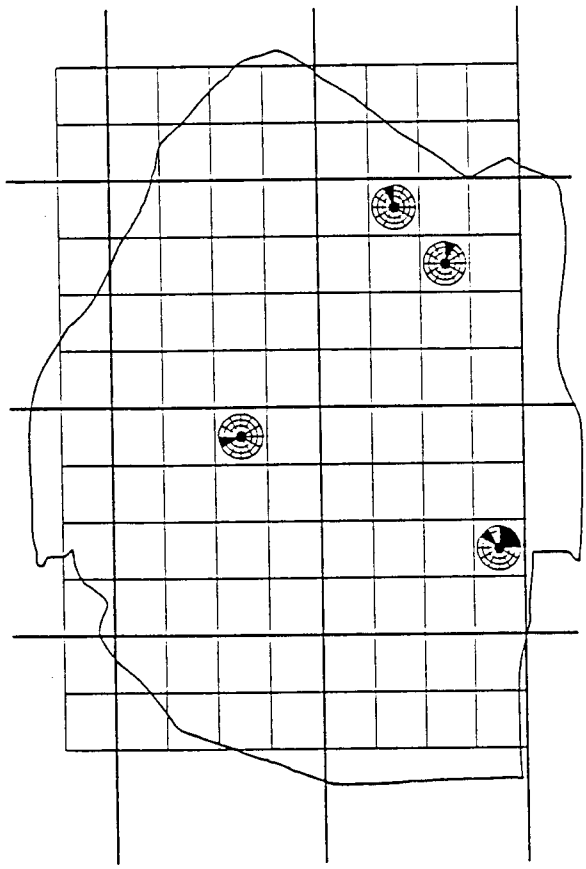
712. Longtailed wagtail. (Motacilla clara)

Recording frequency: 107 (/2263) 5%.
Population estimate: 200.
Status: Uncommon breeding resident.
Habitat preference: Found along fast flowing streams with well wooded banks.



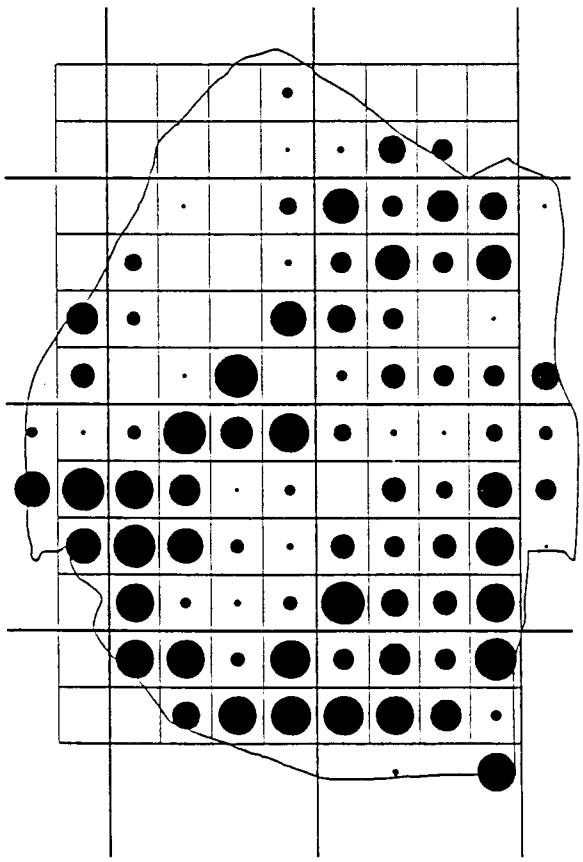
713. Cape wagtail. (Motacilla capensis)

Recording frequency: 616 (/2263) 27%.
Population estimate: 800.
Status: Common breeding resident in the highveld and middleveld and uncommon in the lowveld.
Habitat preference: Dams, rivers and cultivated lands.



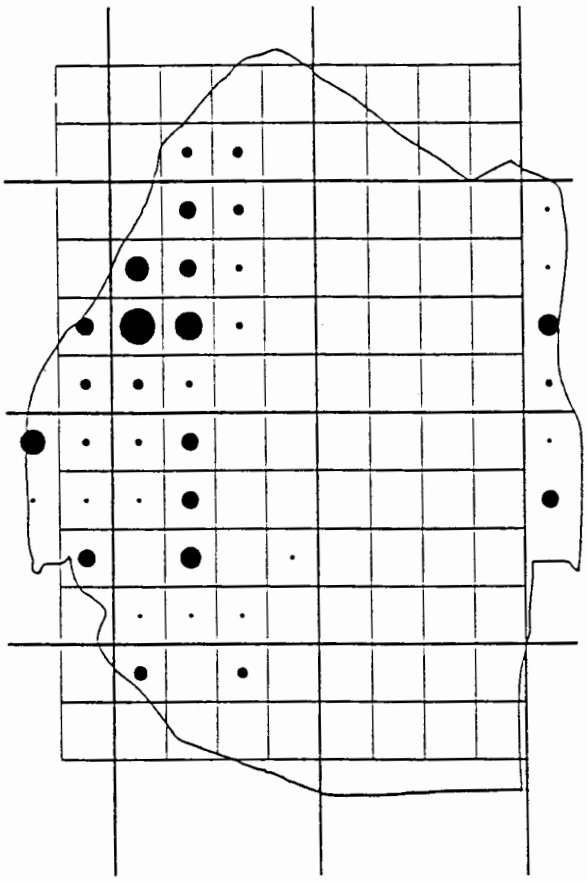
714. Yellow wagtail. (Motacilla flava)

Recording frequency: 10 (/2263) 0,5%.
Status: A summer migrant, encountered regularly at Big Bend (I10), especially around the sugar mill and rarely elsewhere.



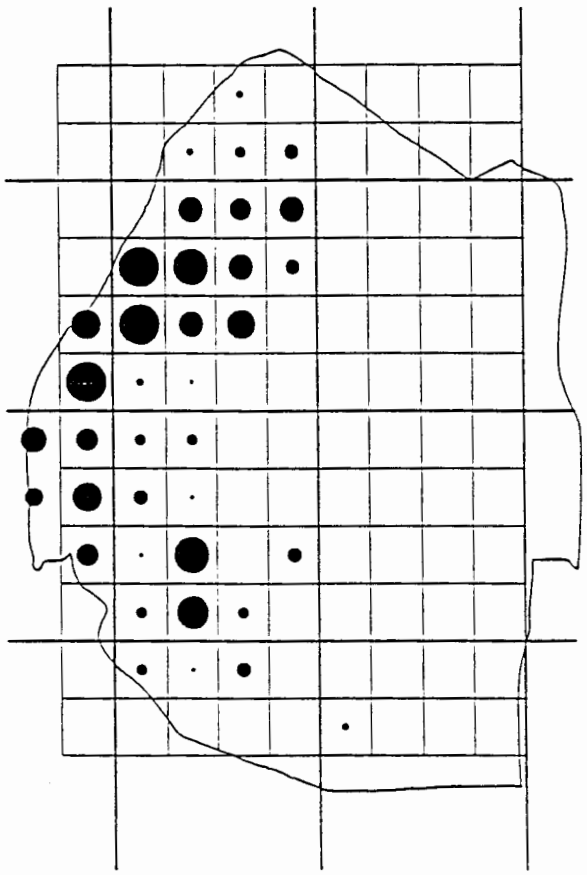
716. Richard's pipit. (Anthus novaeseelandiae)

Recording frequency: 685 (/2263) 30%.
Population estimate: 1 000.
Status: Common breeding resident.
Habitat preference: Flat, short grassland and cultivated lands.



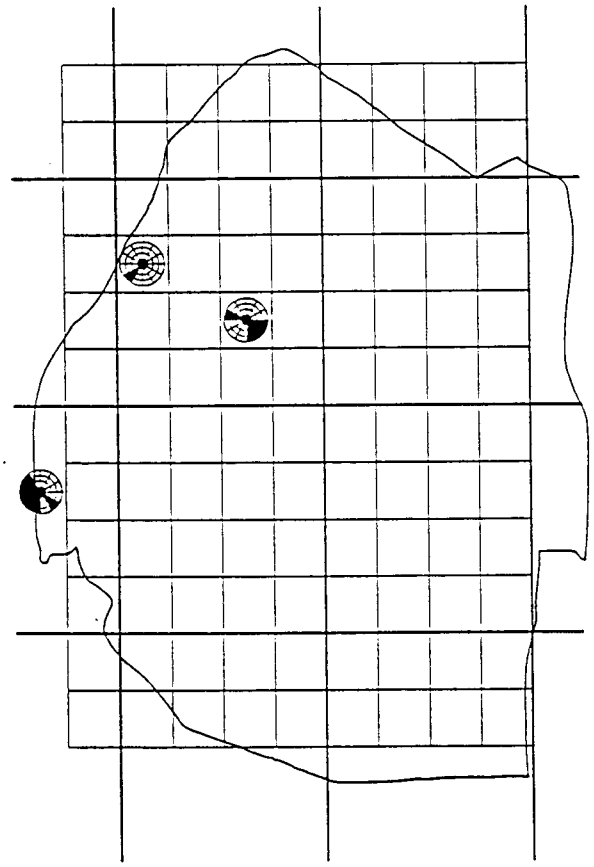
717. Longbilled pipit. (Anthus similis)

Recording frequency: 142 (/2263) 6%.
Population estimate: 300.
Status: Uncommon breeding resident in the highveld and Lubombos.
Habitat preference: Grassland and savanna on rocky slopes.



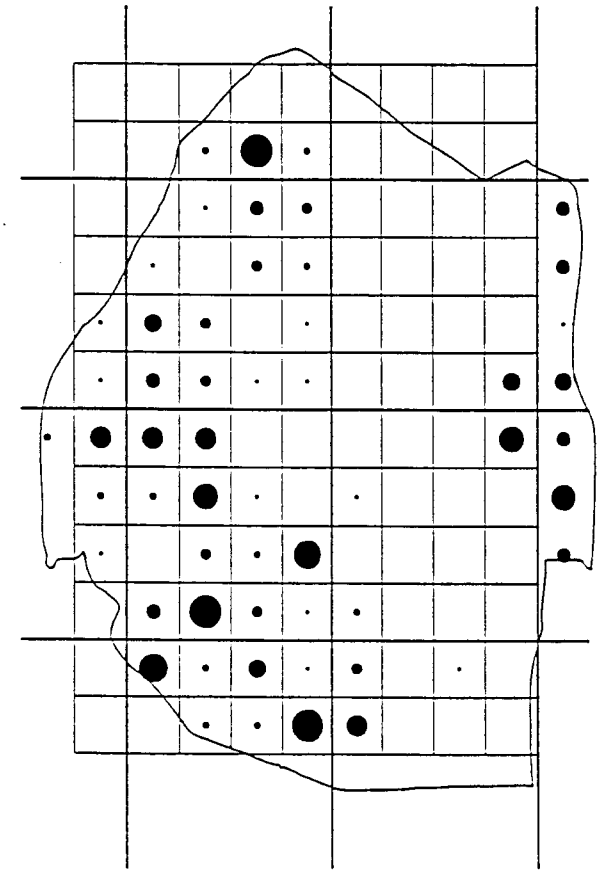
718. Plainbacked pipit. (Anthus leucophrys)

Recording frequency: 227 (/2263) 10%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the highveld.
Habitat preference: Grassland. Is particularly attracted to recently burned ground where it gathers in flocks of up to 20 birds.



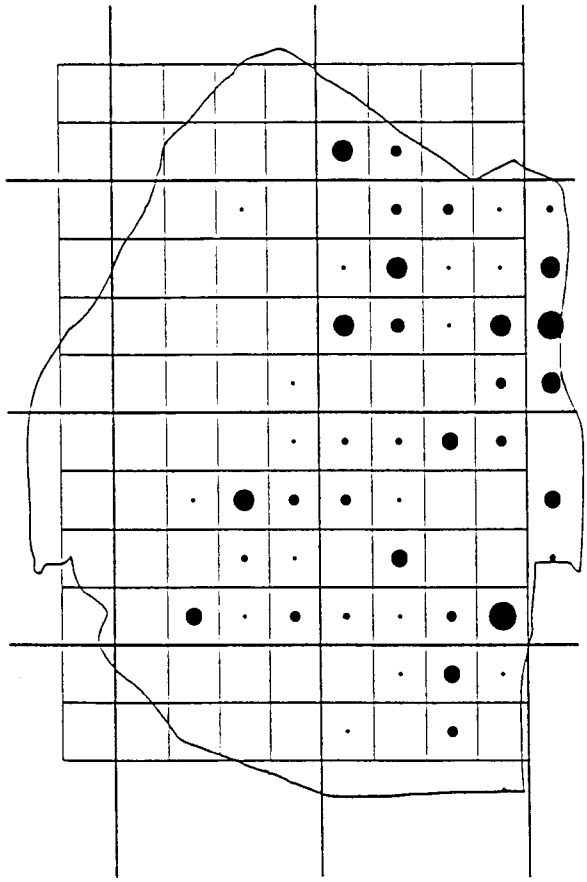
719. Buffy pipit. (Anthus vaalensis)

Recording frequency: 10 (/2263) 0,5 %.
Population estimate: 20.
Status: Rare breeding resident in the highveld. At the two localities where it has been seen repeatedly (E5, H1), the birds were always found within 100 metres of the same spot.
Habitat preference: Grassland.



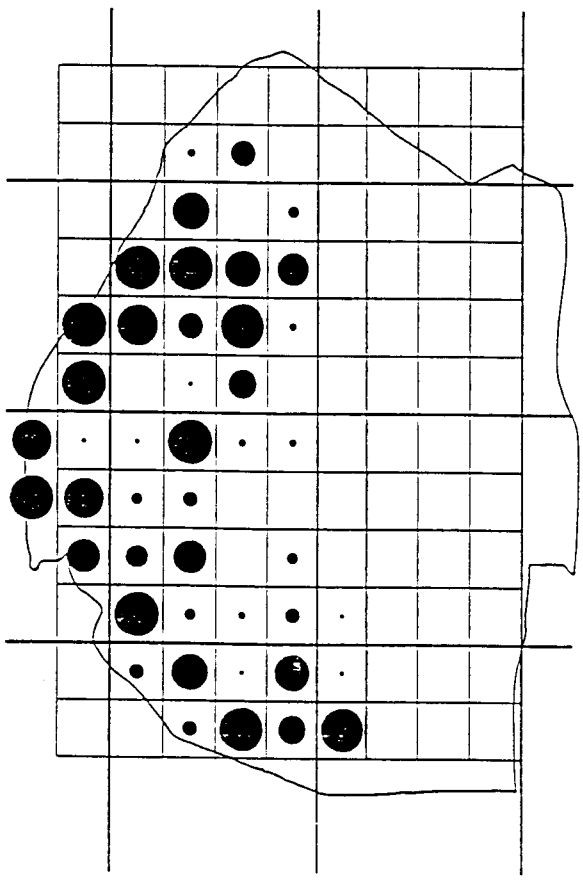
720. Striped pipit. (Anthus lineiventris)

Recording frequency: 209 (/2263) 9%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the highveld, middleveld and Lubombos.
Habitat preference: Woodland, usually on hillsides.



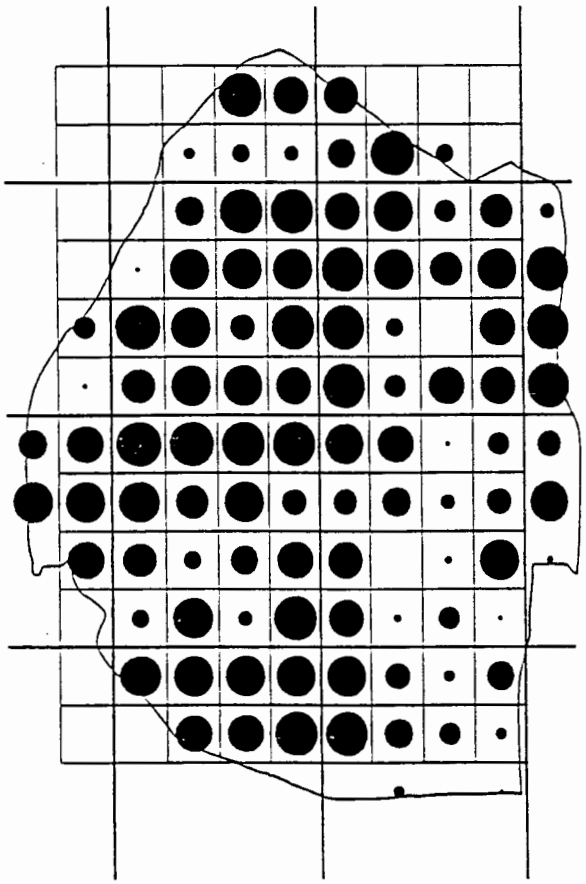
723. Bushveld pipit. (Anthus caffer)

Recording frequency: 151 (/2263) 7%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the lowveld and Lubombos.
Habitat preference: Woodland and savanna. More often associated with broadleaved vegetation than with Acacias.



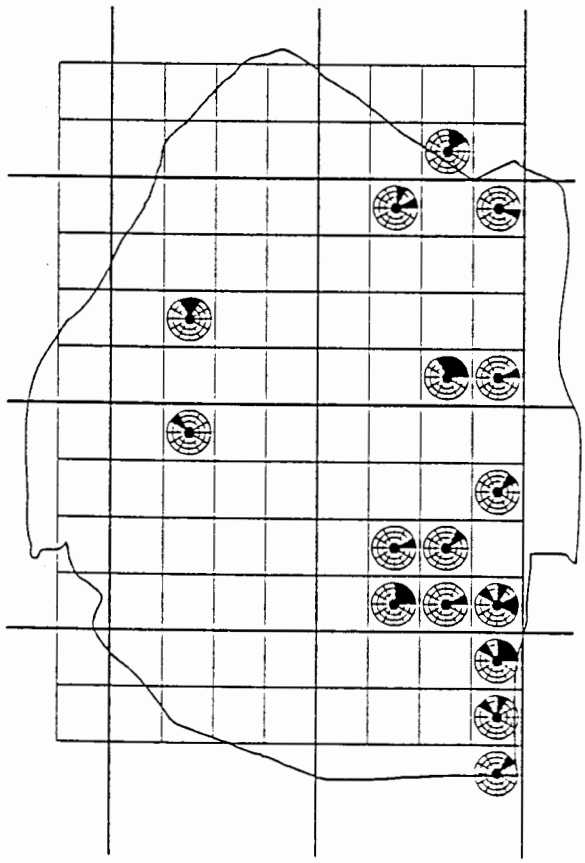
727. Orangethroated longclaw. (Macronyx capensis)

Recording frequency: 408 (/2263) 18%.
Population estimate: 4 000.
Status: Common breeding resident in the highveld.
Habitat preference: Grassland.



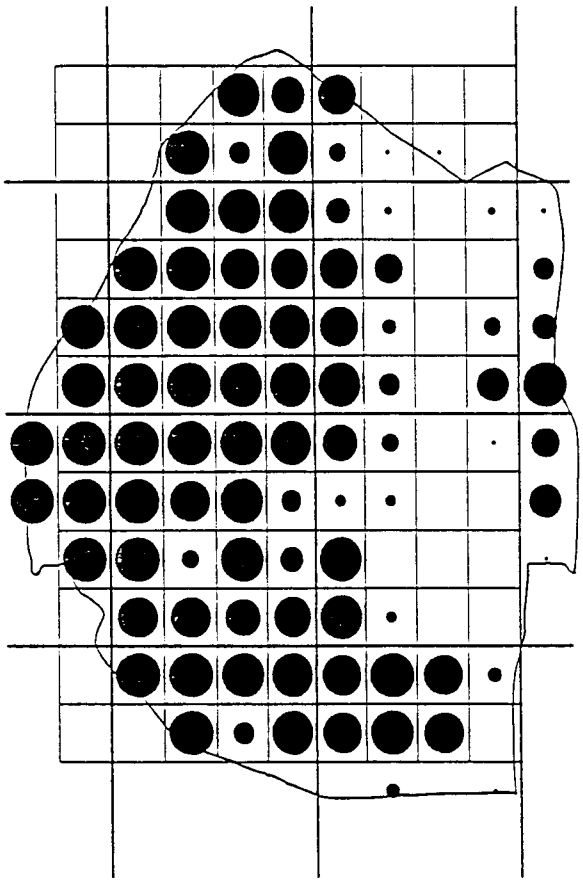
728. Yellowthroated longclaw. (Macronyx croceus)

Recording frequency: 1 084(/2263) 48%.
Population estimate: 10 000.
Status: Common breeding resident.
Habitat preference: Vleis, savanna and clearings in woodland. Occurs in grassland only where trees or bushes are available nearby.



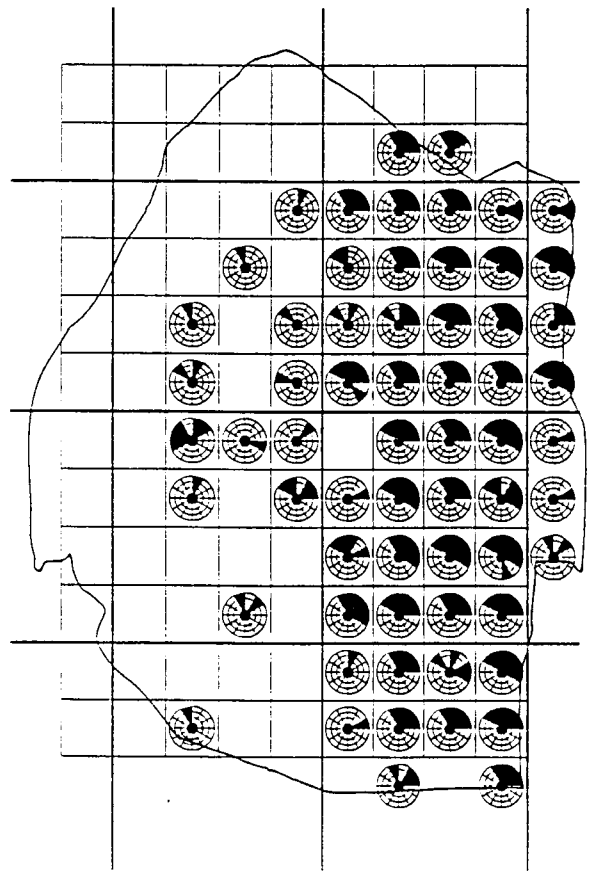
731. Lesser grey shrike. (Lanius minor)

Recording frequency: 32 (/2263) 1%.
Status: A summer migrant, uncommon in the lowveld and rare in the highveld.
Habitat preference: Usually encountered at the roadside in particularly open savanna country. Inhabits scrub woodland in the highveld.



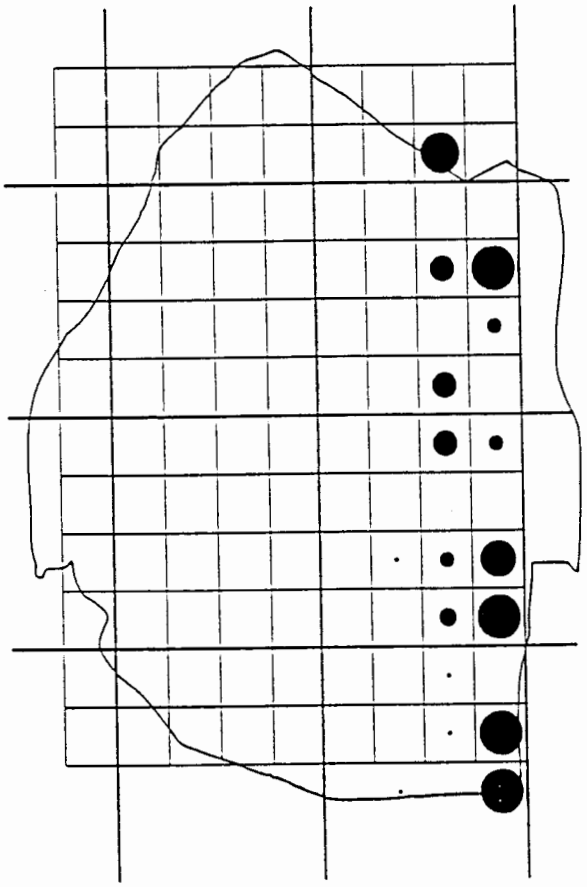
732. Fiscal shrike. (Lanius collaris)

Recording frequency: 1 204 (/2263) 53%.
Population estimate: 15 000.
Status: Very common breeding resident in most areas but largely absent from the eastern lowveld. The gap in its distribution coincides with the presence of the Longtailed Shrike.
Habitat preference: Grassland, savanna, clearings, gardens and cultivated land. Often encountered at the roadside.



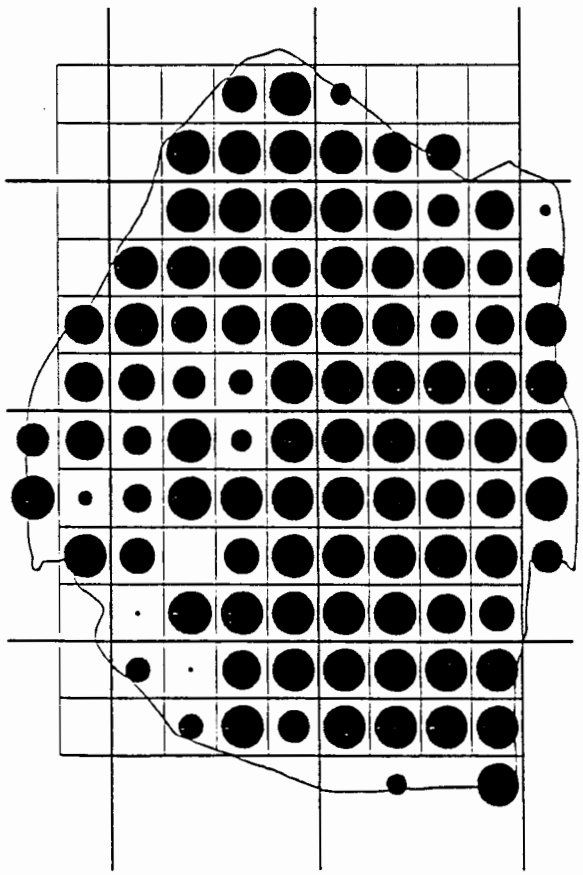
733. Redbacked shrike. (Lanius collurio)

Recording frequency: 300 (/2263) 13%.
Status: A summer migrant, common in the lowveld and uncommon in the middleveld and Lubombos.
Habitat preference: Woodland and savanna.



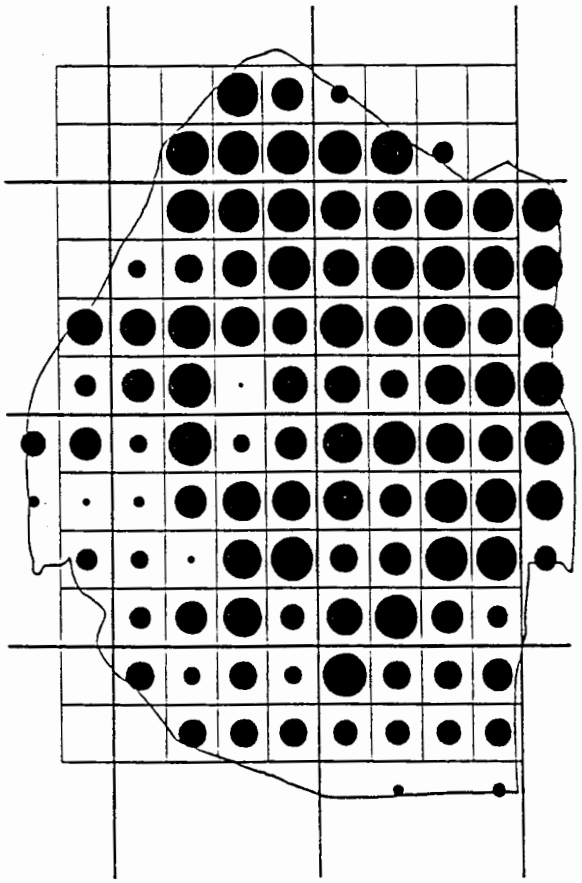
735. Longtailed shrike. (Corvinella melanoleuca)

Recording frequency: 138 (/2263) 6%.
Population estimate: 300.
Status: Uncommon breeding resident in the eastern lowveld.
Habitat preference: Knobthorn-marula savanna.



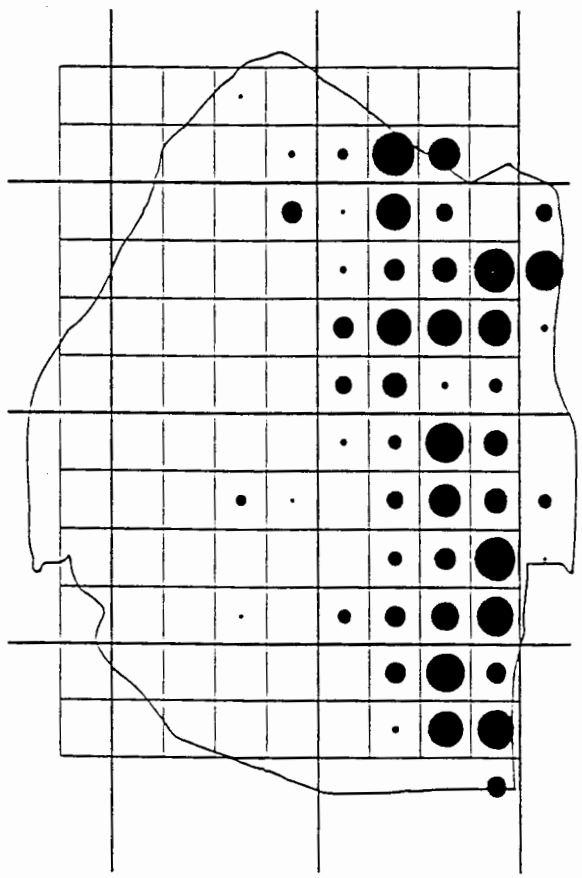
736. Southern boubou. (Laniarius ferrugineus)

Recording frequency: 1 487 (/2263) 66%.
Population estimate: 100 000.
Status: Very common breeding resident.
Habitat preference: Forest and woodland and thickets in savanna country.



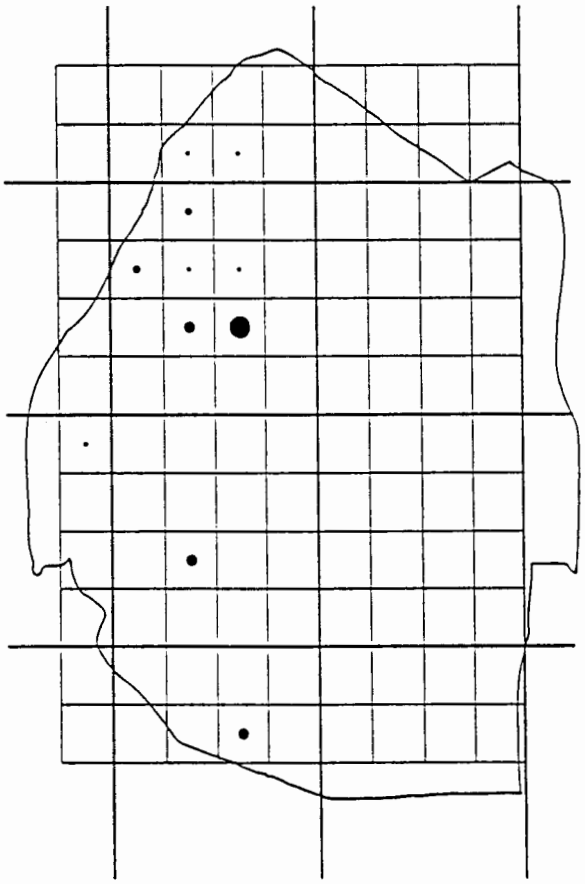
740. Puffback. (Dryoscopus cubla)

Recording frequency: 1 396 (/2263) 62%.
Population estimate: 50 000.
Status: Very common breeding resident.
Habitat preference: Forest, woodland and savanna.



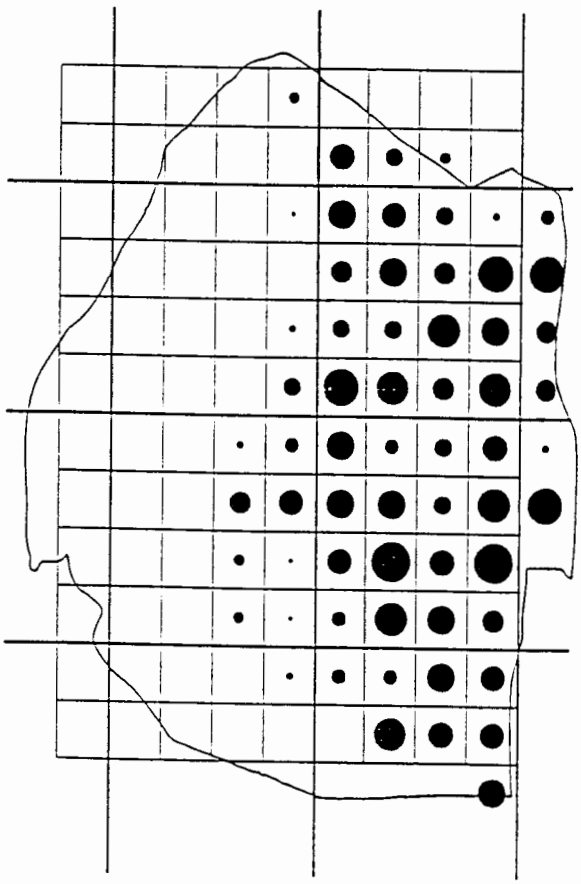
741. Brubru. (Nilaus afer)

Recording frequency: 371 (/2263) 16%.
Population estimate: 5 000.
Status: Uncommon breeding resident in the lowveld and Lubombos and vagrant in the middleveld.
Habitat preference: Woodland and savanna.



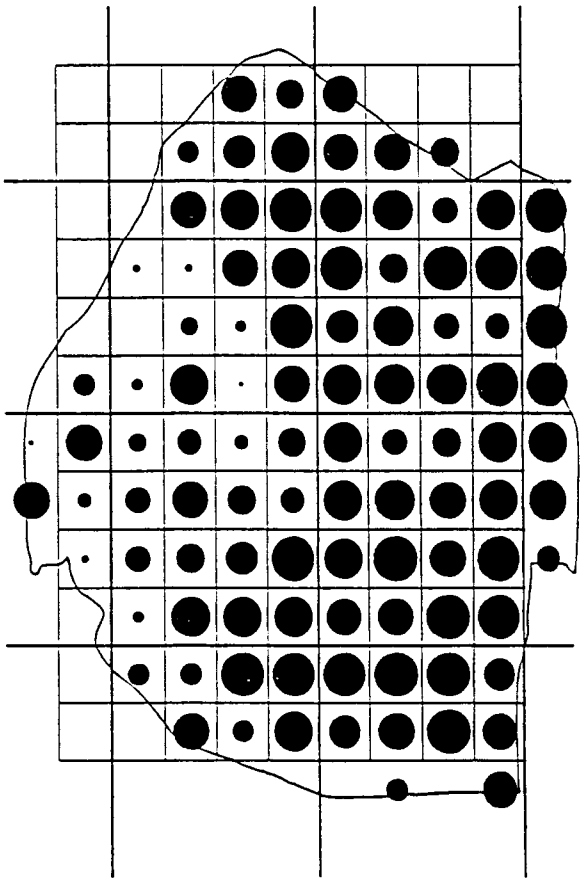
742. Southern tchagra. (Tchagra tchagra)

Recording frequency: 22 (/2263) 1%.
Population estimate: 60.
Status: Uncommon breeding resident or possibly a summer migrant in the highveld.
Habitat preference: Woodland and forest fringes.



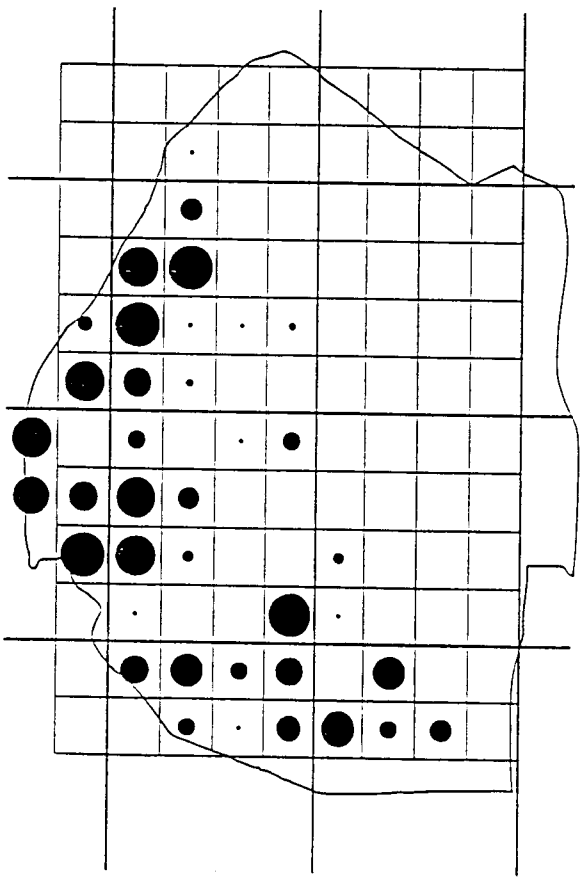
743. Threestreaked tchagra. (Tchagra australis)

Recording frequency: 432 (/2263) 19%.
Population estimate: 8 000.
Status: Uncommon breeding resident in the lowveld and Lubombos.
Habitat preference: Acacia woodland and savanna.



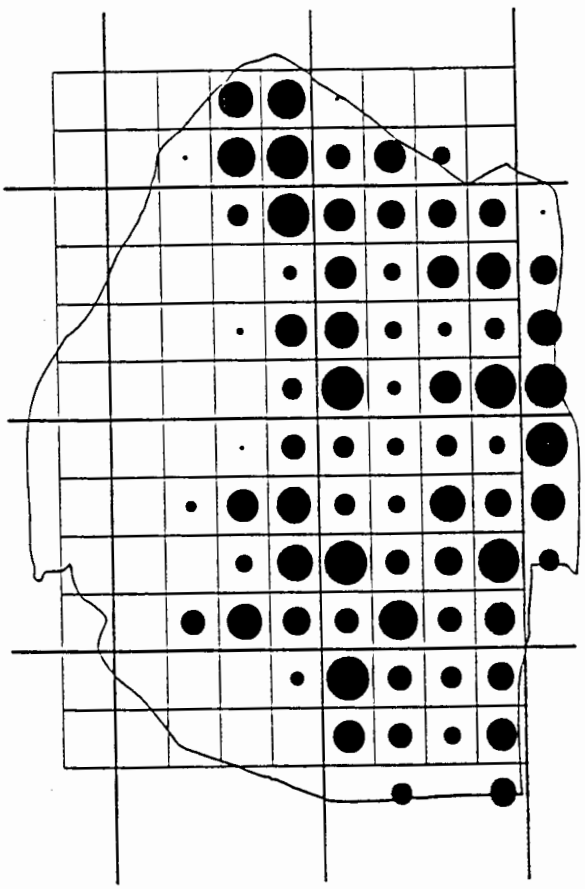
744. Blackcrowned tchagra. (Tchagra senegala)

Recording frequency: 1 118 (/2263) 49%.
Population estimate: 20 000.
Status: A breeding resident, common in the middleveld,lowveld and Lubombos and uncommon in the highveld.
Habitat preference: Woodland and savanna.



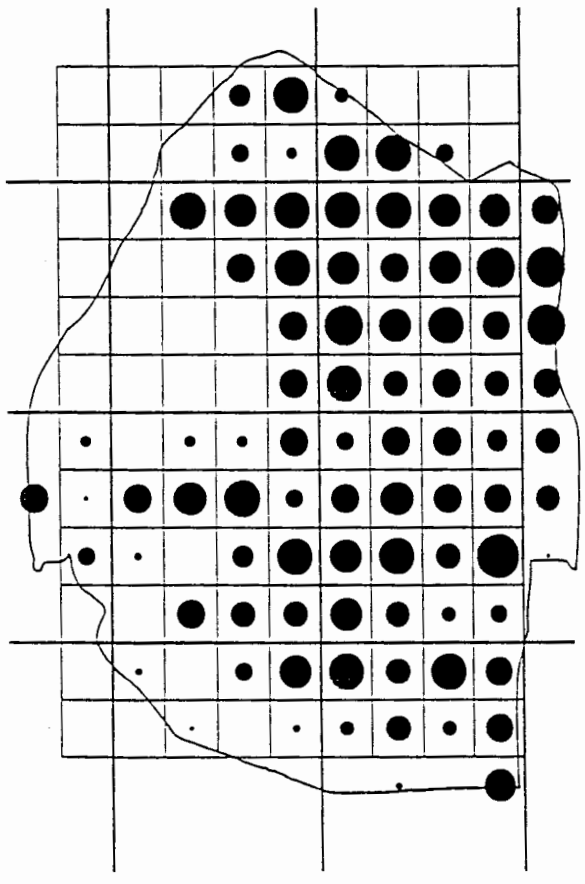
746. Bokmakierie. (Telophorus zeylonus)

Recording frequency: 289 (/2263) 13%.
Population estimate: 3 000.
Status: Uncommon breeding resident in the highveld and southern middleveld.
Habitat preference: Rocky outcrops and scrub woodland.



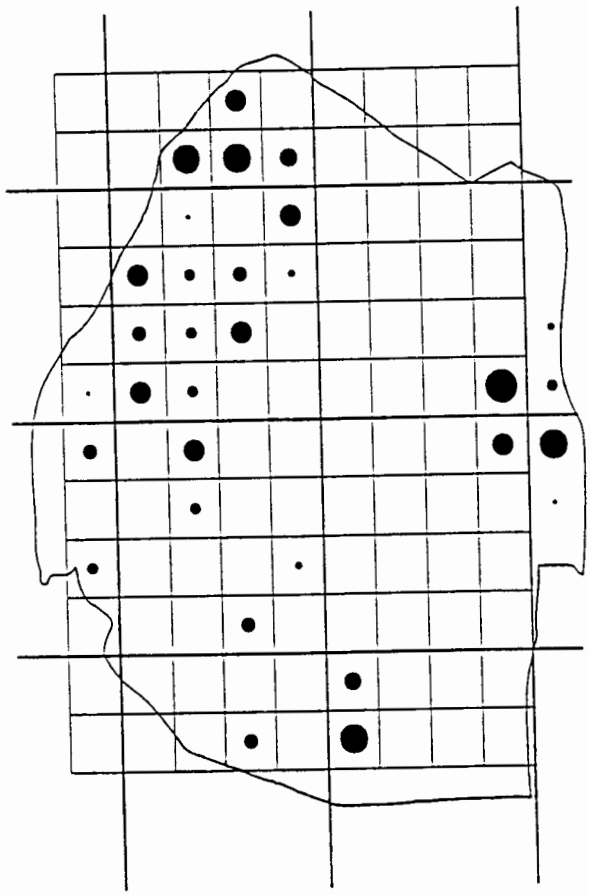
747. Gorgeous bush shrike. (Telophorus quadricolor)

Recording frequency: 666 (/2263) 29%.
Population estimate: 10 000.
Status: Common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Thickets in woodland and savanna.



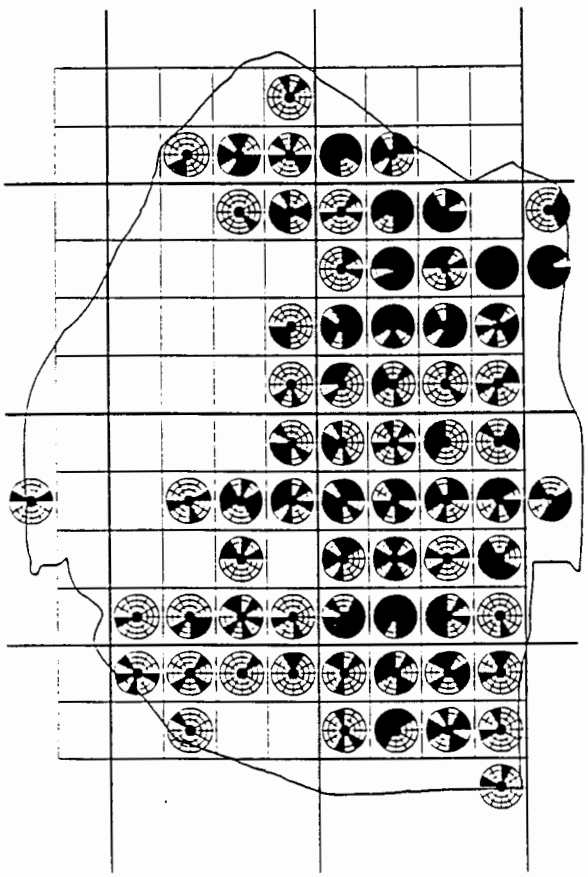
748. Orangebreasted bush shrike. (Telophorus sulfureopectus)

Recording frequency: 711 (/2263) 31%.
Population estimate: 12 000.
Status: Common breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland and savanna.



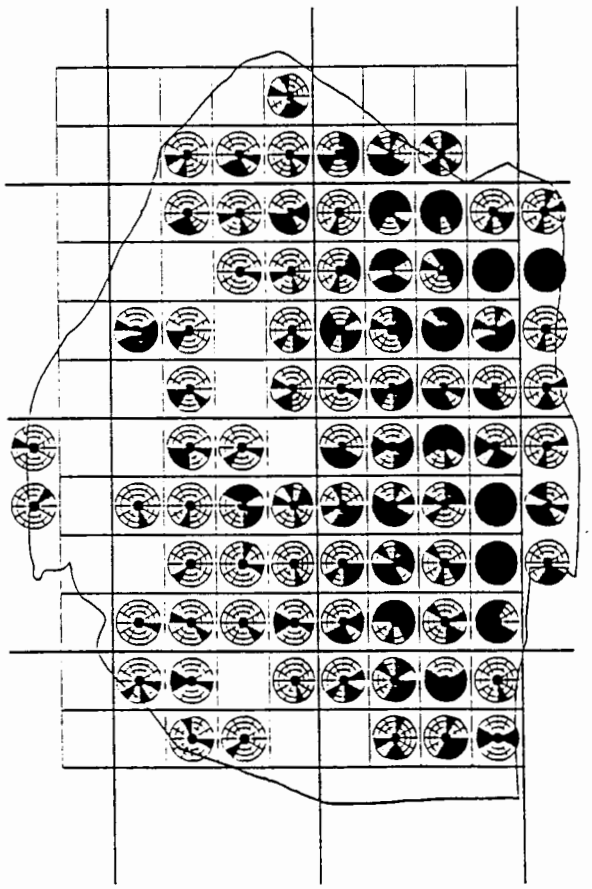
750. Olive bush shrike. (Telophorus olivaceus)

Recording frequency: 159 (/2263) 7%.
Population estimate: 1 000.
Status: Uncommon breeding resident in the highveld, middleveld and higher parts of the Lubombos.
Habitat preference: Forest and dense woodland.



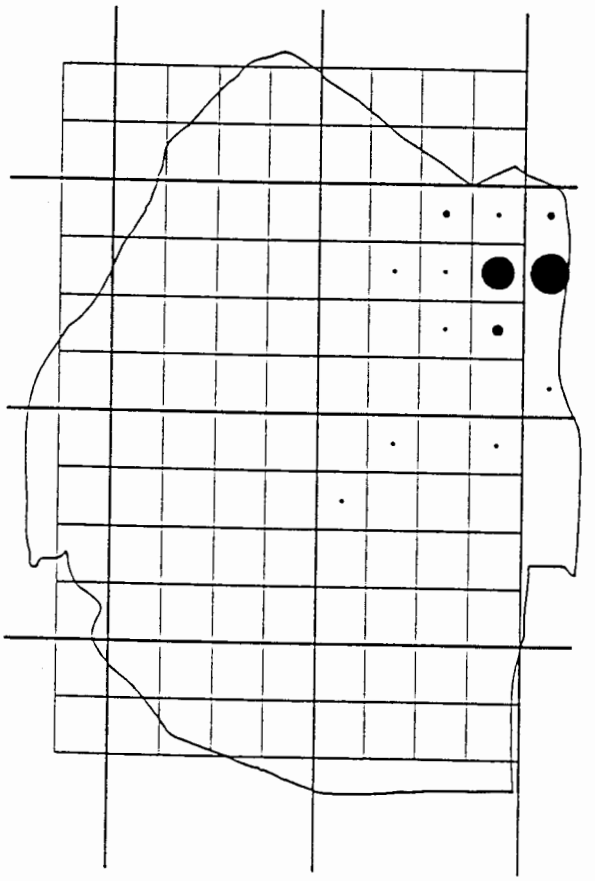
751. Greyheaded bush shrike. (Malaconotus blanchoti)

Recording frequency: 446 (/2263) 20%.
Population estimate: 2 000.
Status: A breeding resident, common in the lowveld and uncommon in the Lubombos, middleveld and southern highveld.
Habitat preference: Woodland and savanna. Inhabits gum plantations in the southern highveld.



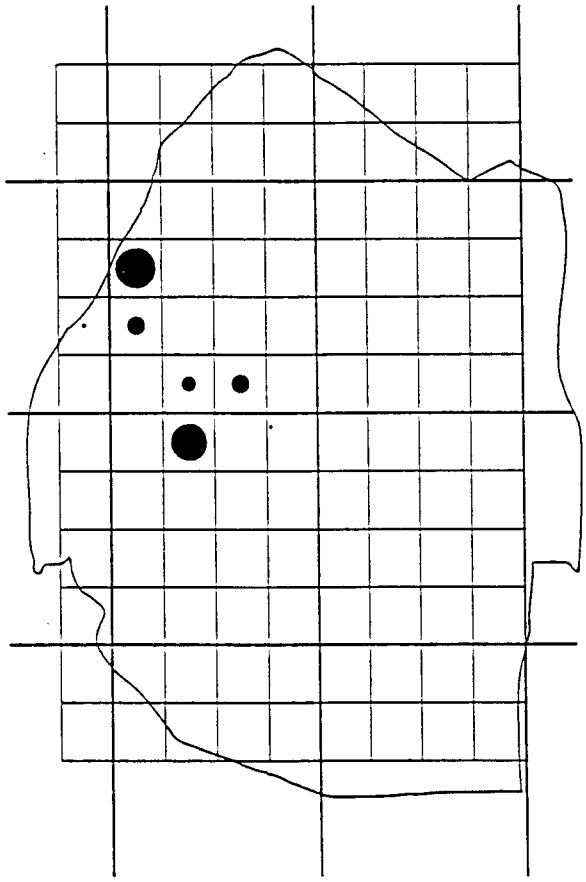
753. White helmetshrike. (Prionops plumatus)

Recording frequency: 506 (/2263) 22%.
Population estimate: 4 000.
Status: Common breeding resident in the lowveld and uncommon visitor (mainly winter) in other regions. During the winter of 1992 (after data collection for the atlas had ended) the species invaded the highveld in unprecedented numbers.
Habitat preference: Woodland and savanna.



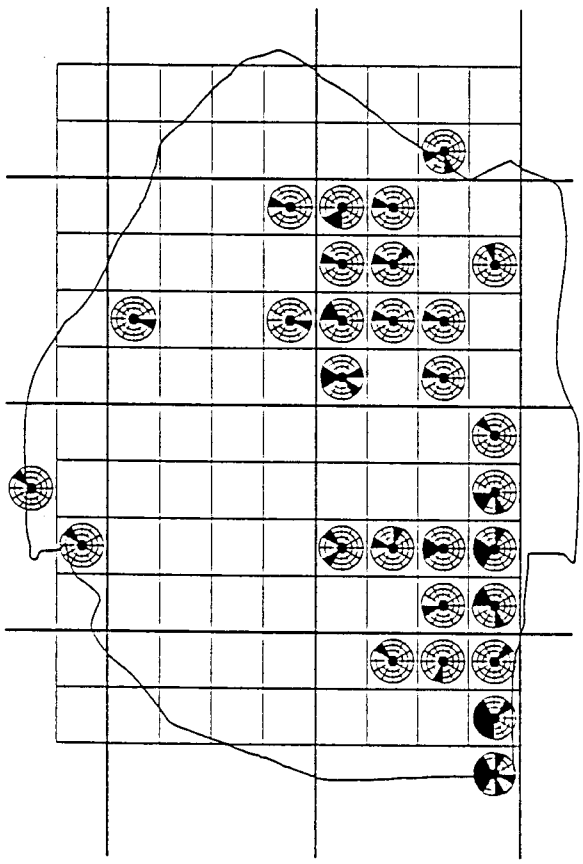
754. Redbilled helmetshrike. (Prionops retzii)

Recording frequency: 64 (/2263) 3%.
Population estimate: 100.
Status: Uncommon breeding resident in the lowveld and Lubombos. A single bird was seen in the Mlumati valley (A5) in the north west during July 1992, after completion of data collection for the atlas.
Habitat preference: Woodland.



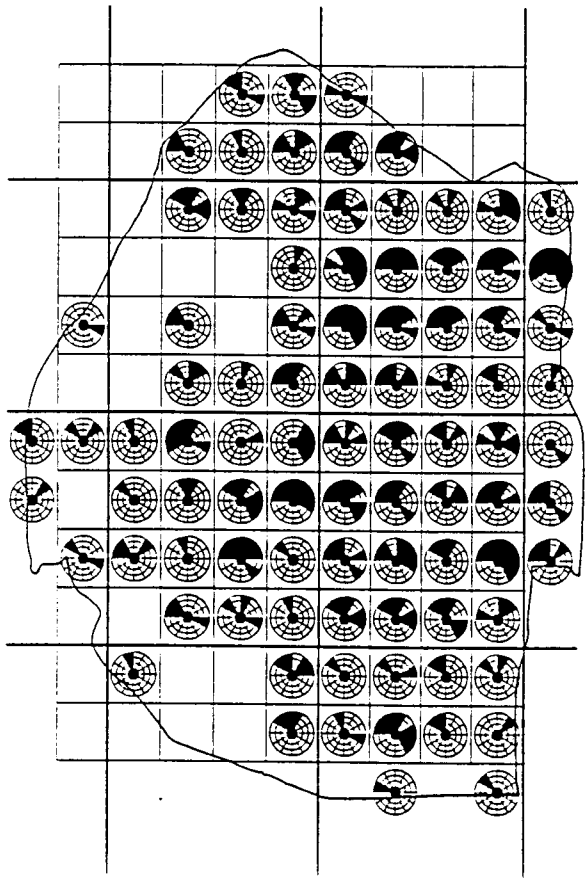
759. Pied starling. (Spreo bicolor)

Recording frequency: 52 (/2263) 2%.
Population estimate: 60.
Status: Uncommon breeding resident in the highveld.
Habitat preference: Grassland, vleis and cultivated lands.



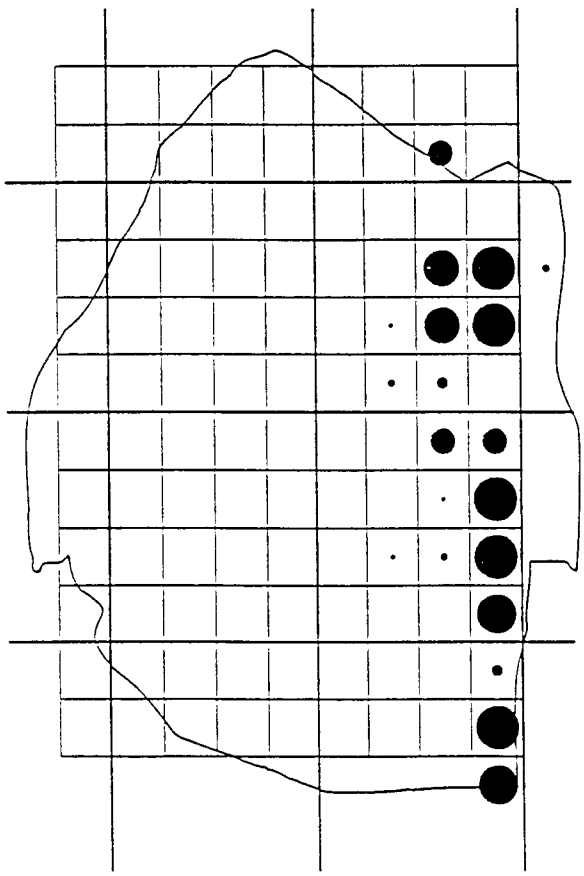
760. Wattled starling. (Creatophora cinerea)

Recording frequency: 59 (/2263) 3%.
Population estimate: 100.
Status: Uncommon breeding resident in the lowveld and vagrant elsewhere. Numbers probably vary very widely from year to year. The species appeared to be most numerous in the far south near Lavumisa (M10), where several flocks each numbering more than 100 birds have been encountered. Further north the birds occurred in ones and twos or flocks of up to 20 birds. Males in full breeding plumage have been observed near Mafutseni in November.
Habitat preference: Acacia savanna.



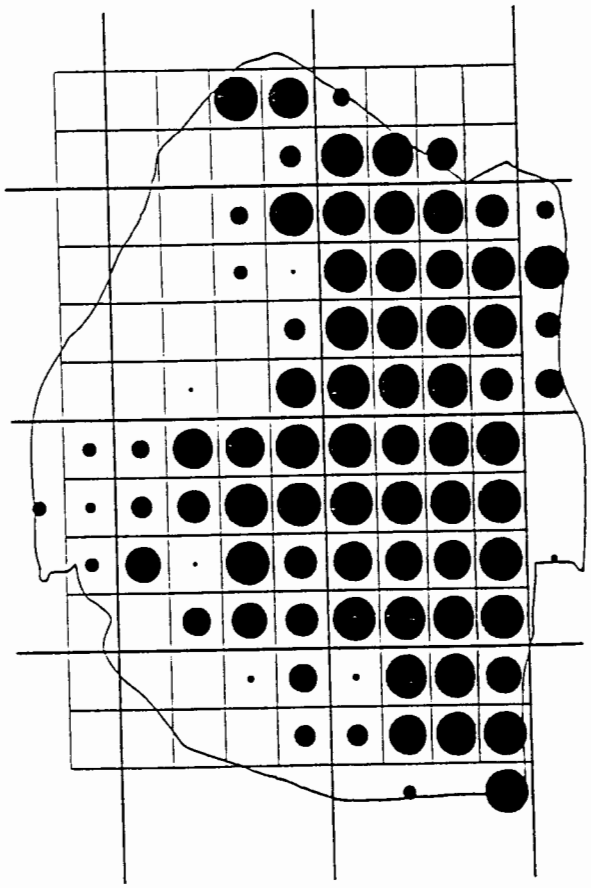
761. Plumcoloured starling. (Cinnyricinclus leucogaster)

Recording frequency: 399 (/2263) 18%.
Population estimate: 2 000.
Status: Common breeding summer migrant.
Habitat preference: Woodland and savanna.



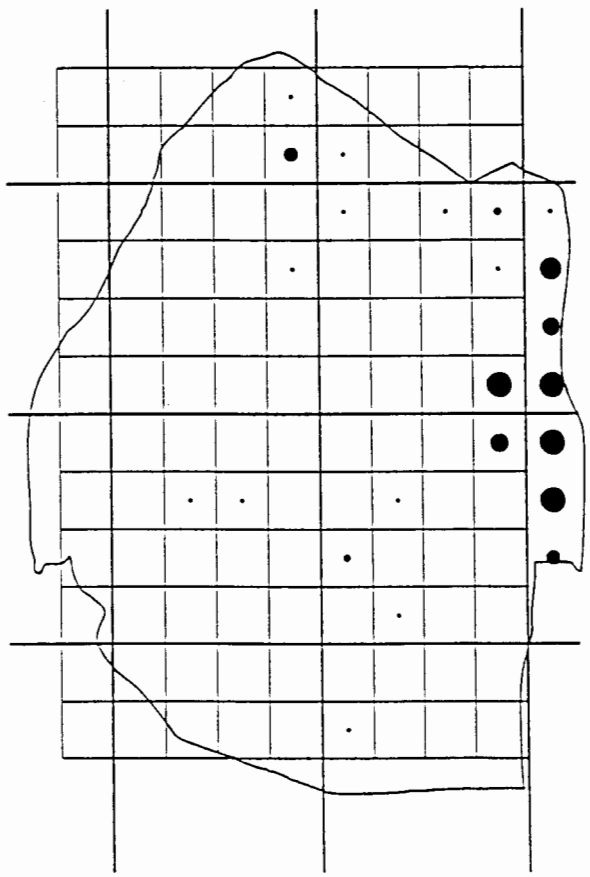
762. Burchell's starling. (Lamprotornis australis)

Recording frequency: 225 (/2263) 10%.
Population estimate: 200.
Status: Uncommon breeding resident in the eastern lowveld.
Habitat preference: Knobthorn-marula savanna.



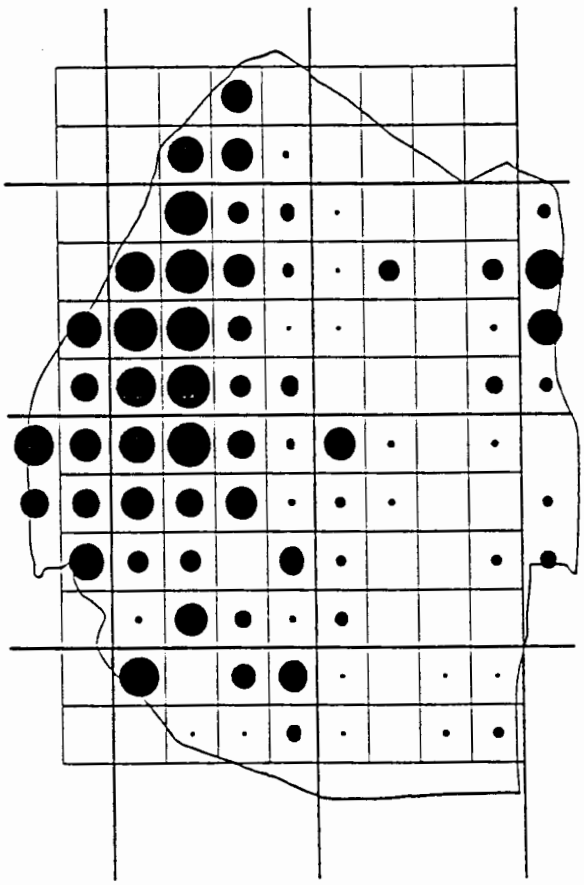
764. Glossy starling. (Lamprotornis nitens)

Recording frequency: 1 075 (/2263) 48%.
Population estimate: 30 000.
Status: A breeding resident, common in the lowveld and uncommon in the middleveld and Lubombos.
Habitat preference: Woodland and savanna.



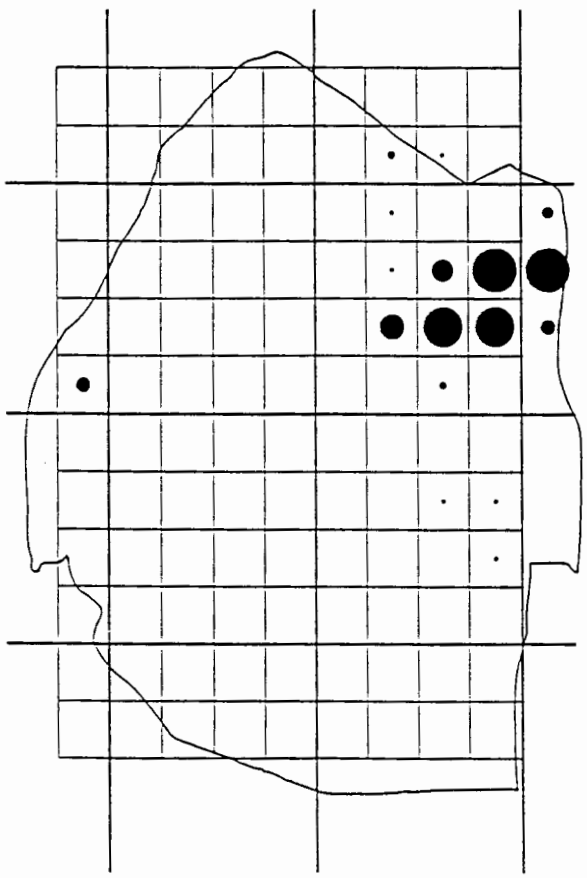
768. Blackbellied starling. (Lamprotornis corruscus)

Recording frequency: 71 (/2263) 3%.
Population estimate: 400.
Status: Common breeding resident in the Lubombos and uncommon visitor in the lowveld and middleveld.
Habitat preference: Forest and dense woodland.



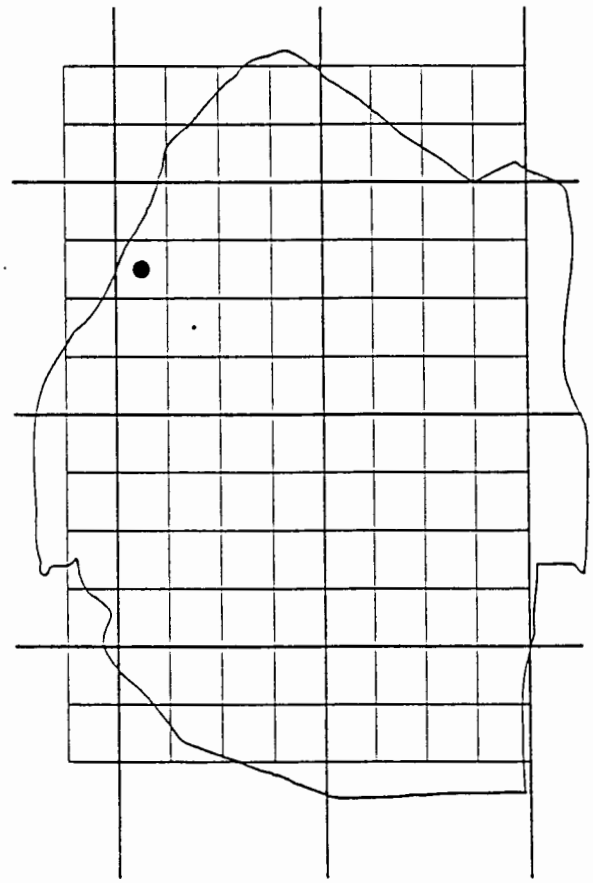
769. Redwinged starling. (Onychognathus morio)

Recording frequency: 751 (/2263) 33%.
Population estimate: 20 000.
Status: A breeding resident, common in the highveld and uncommon in other regions.
Habitat preference: Inhabits woodland in mountainous areas.



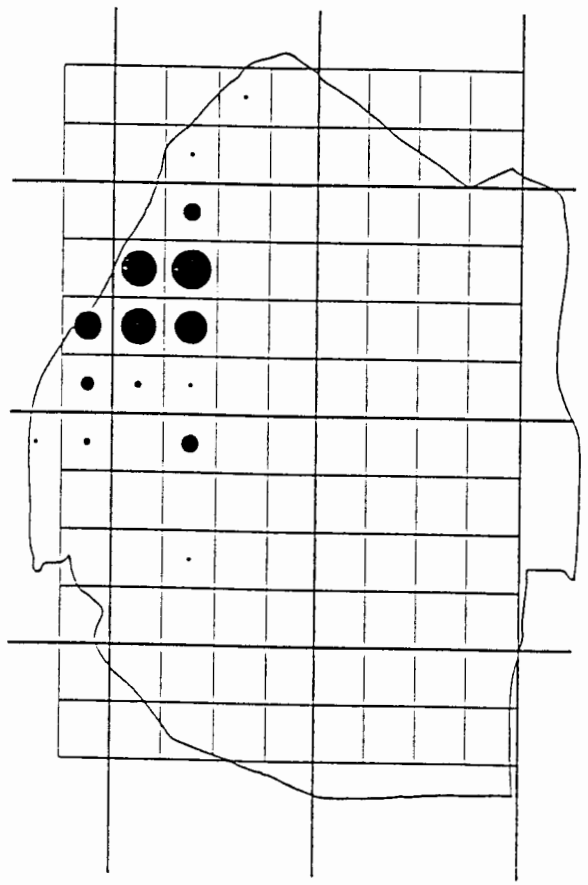
772. Redbilled oxpecker. (Buphagus erythrorhynchus)

Recording frequency: 143 (/2263) 6%.
Population estimate: 400.
Status: Uncommon breeding resident in the lowveld and at one locality in the highveld (F2). Prior to 1972, the species was very rare or absent from the Hlane (D9, E9, E10) and Mlawula (D10, D11, E10) reserves, but numbers increased rapidly since then and it is now fairly common within these reserves (J. Culverwell, R. Girdwood pers. comm.).
Habitat preference: Woodland and savanna (and grassland in the highveld).



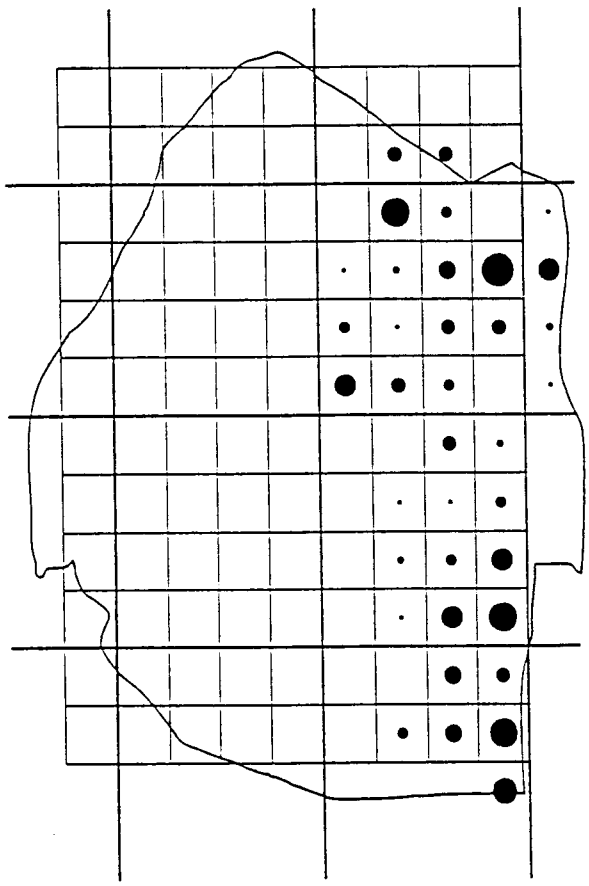
774. Gurney's sugarbird. (Promerops gurneyi)

Recording frequency: 6 (/2263) 0,4%.
Population estimate: 10.
Status: Rare breeding resident at one locality on Ngwenya Mountain in the highveld (D3).
Habitat preference: Protea roupelliae woodland.



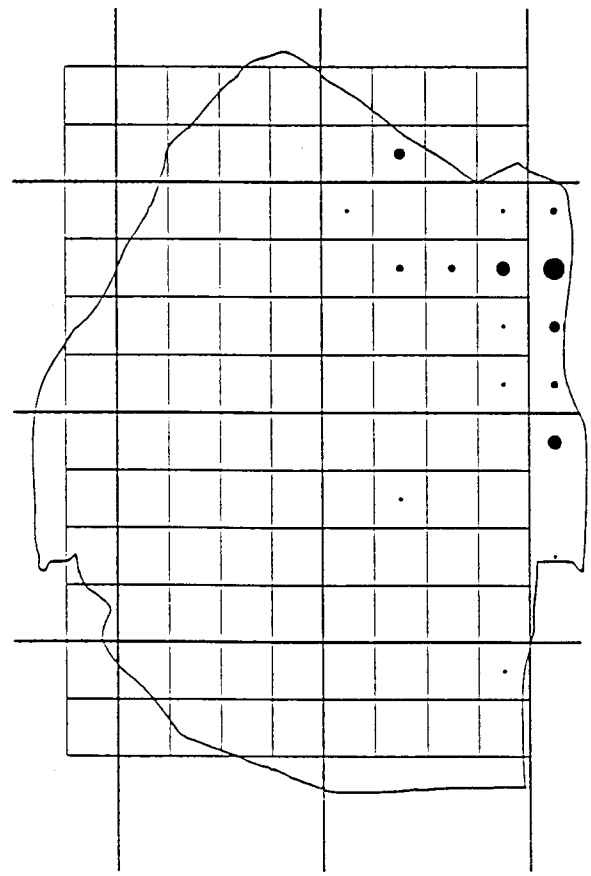
775. Malachite sunbird. (Nectarinia famosa)

Recording frequency: 111 (/2263) 5%.
Population estimate: 400.
Status: Uncommon breeding resident in the northern highveld.
Habitat preference: Scrub woodland and rocky outcrops in grassland.



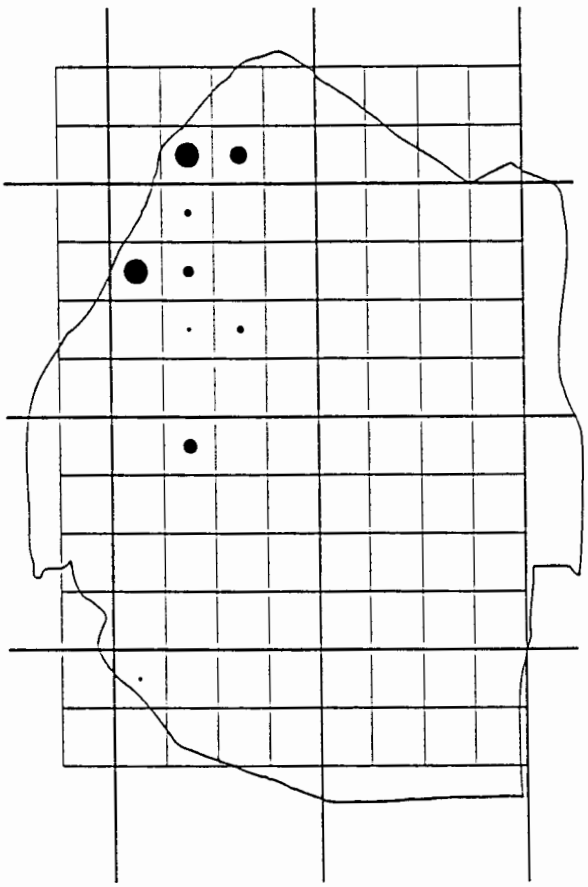
779. Marico sunbird. (Nectarinia mariquensis)

Recording frequency: 169 (/2263) 7%.
Population estimate: 800.
Status: Uncommon breeding resident in the lowveld and Lubombos.
Habitat preference: Woodland and savanna.



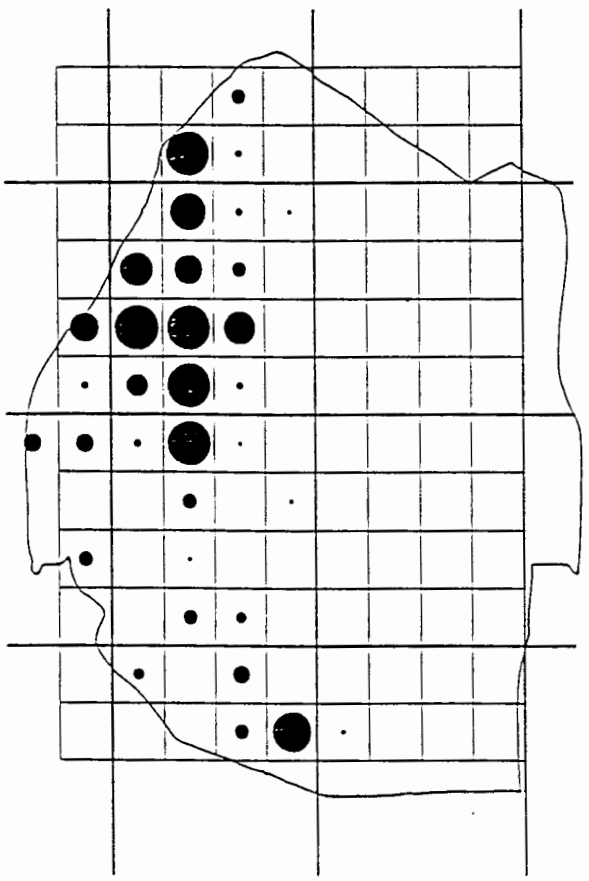
780. Purplebanded sunbird. (Nectarinia bifasciata)

Recording frequency: 37 (/2263) 2%.
Population estimate: 200.
Status: Uncommon breeding resident in the lowveld and Lubombos.
Habitat preference: Mature woodland.



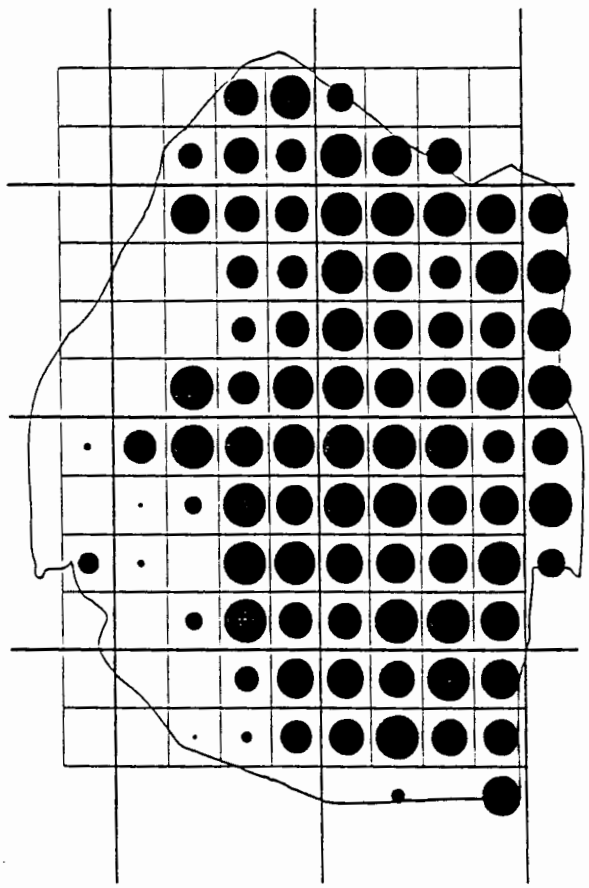
783. Lesser doublecollared sunbird. (Nectarinia chalybea)

Recording frequency: 39 (/2263) 2%.
Population estimate: 200.
Status: Uncommon breeding resident in the highveld.
Habitat preference: Forest, wattle stands and timber plantations.



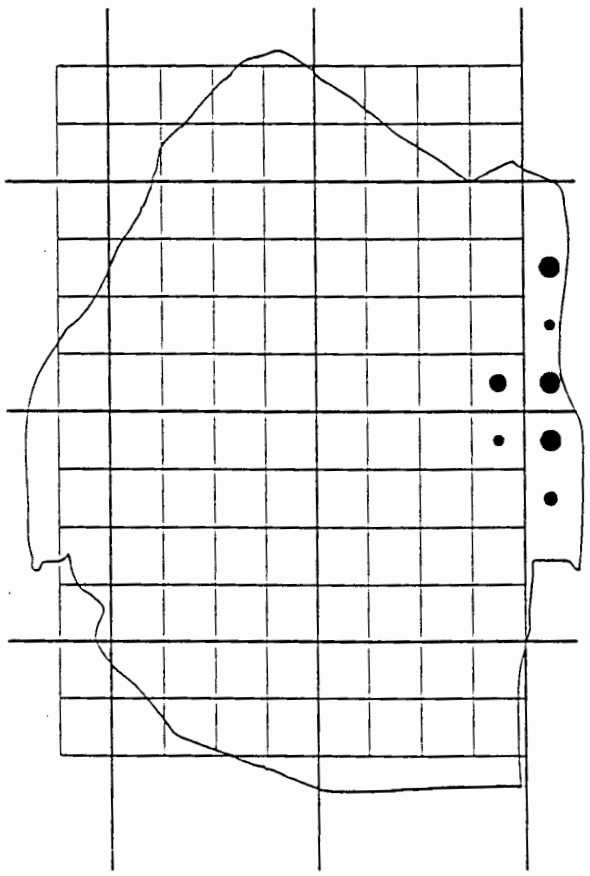
785. Greater doublecollared sunbird. (Nectarinia afra)

Recording frequency: 381 (/2263) 17%.
Population estimate: 5 000.
Status: Uncommon breeding resident in the highveld and middleveld.
Habitat preference: Woodland, scrub woodland and rocky outcrops in grassland.



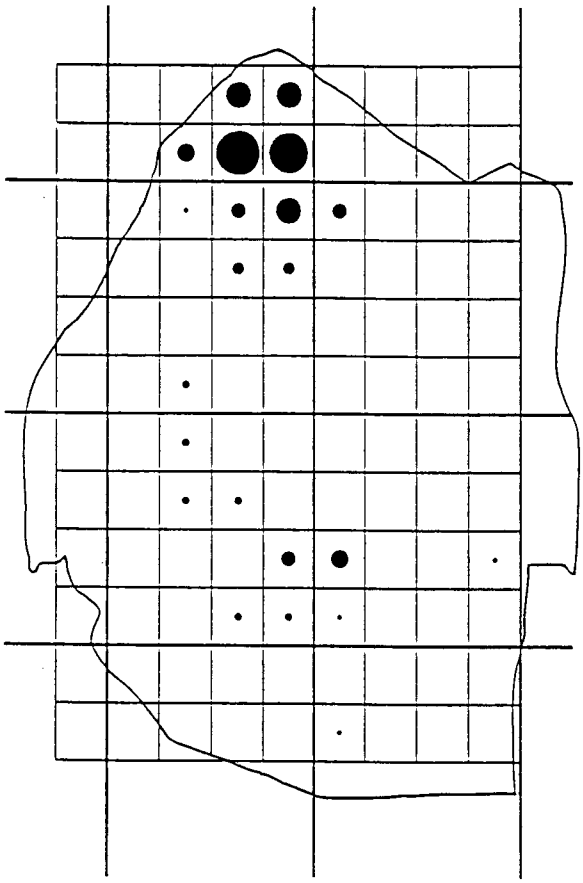
787. Whitebellied sunbird. (Nectarinia talatala)

Recording frequency: 1 289 (/2263) 57%.
Population estimate: 80 000.
Status: Very common resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland and savanna.



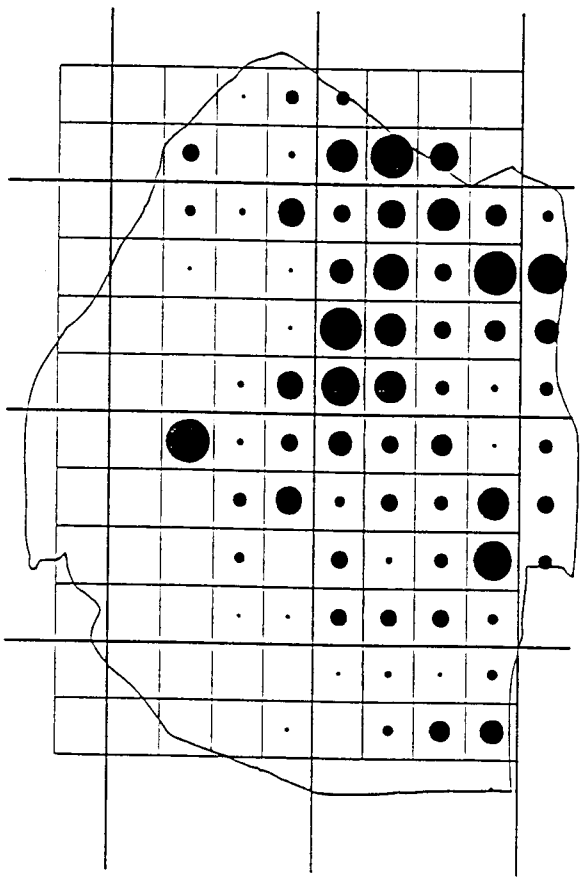
789. Grey sunbird. (Nectarinia veroxii)

Recording frequency: 36 (/2263) 2%.
Population estimate: 50.
Status: Uncommon breeding resident in the Lubombos.
Habitat preference: Forest and woodland.



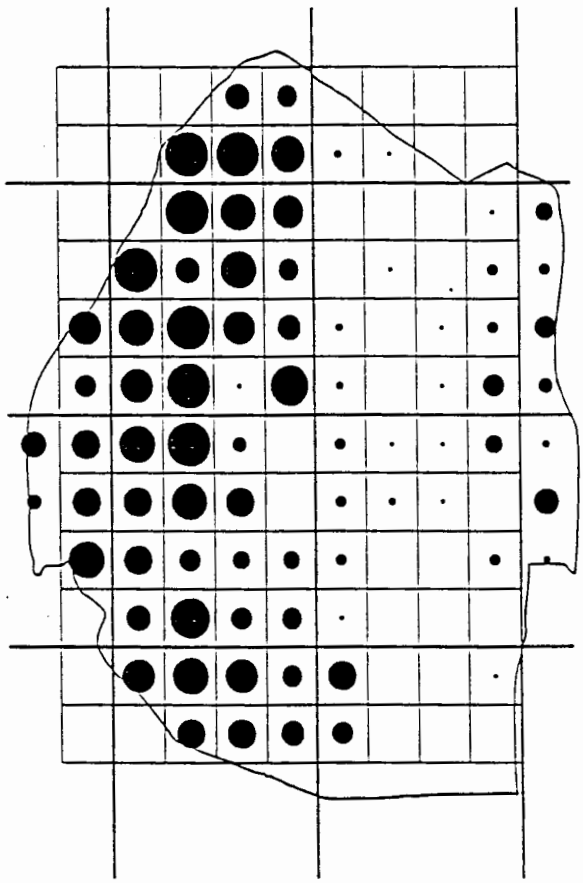
790. Olive sunbird. (Nectarinia olivacea)

Recording frequency: 112 (/2263) 5%.
Population estimate: 400.
Status: A breeding resident in the middleveld, common in the north and uncommon in the south.
Habitat preference: Woodland and forest.



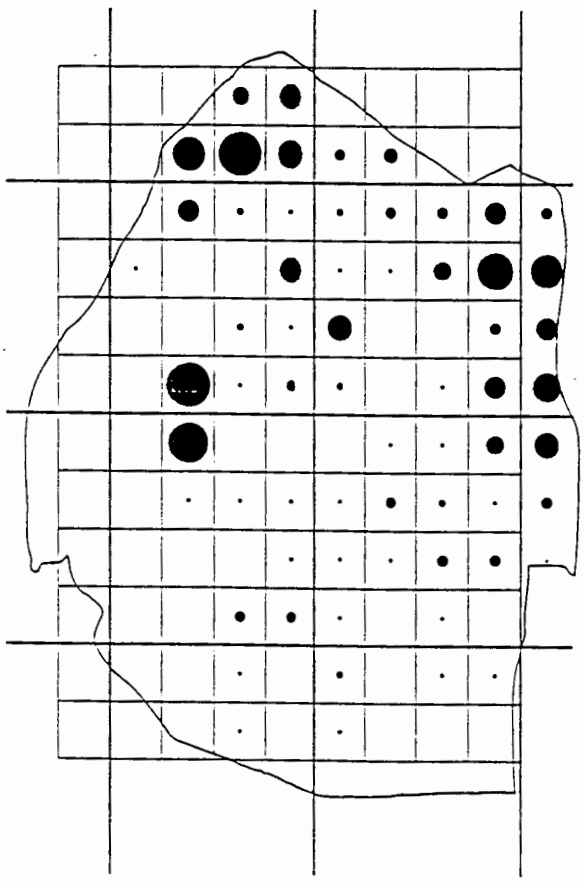
791. Scarletchested sunbird. (Nectarinia senegalensis)

Recording frequency: 533 (/2263) 24%.
Population estimate: 7 000.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos.
Habitat preference: Woodland and savanna.



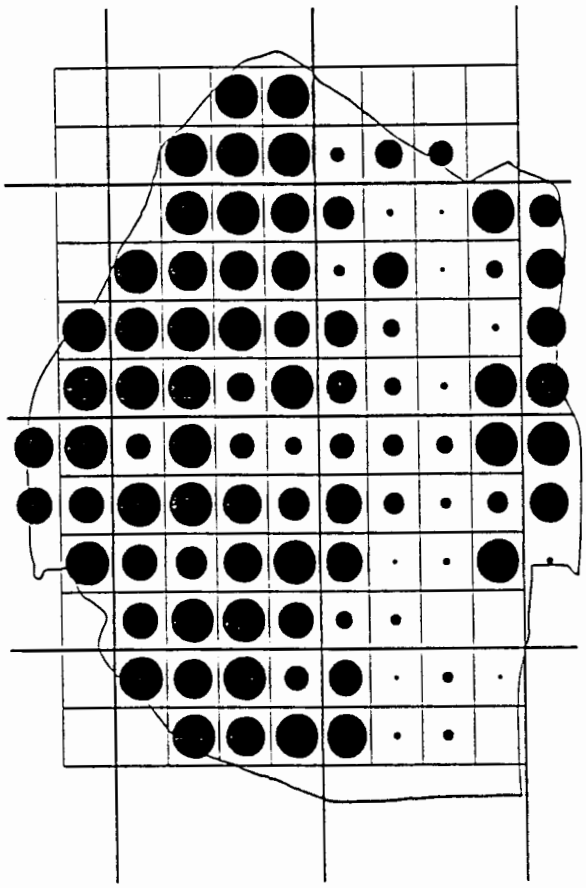
792. Black sunbird. (Nectarinia amethystina)

Recording frequency: 771 (/2263) 34%.
Population estimate: 20 000.
Status: A breeding resident, common in the highveld and middleveld, uncommon in the Lubombos and an uncommon visitor in the lowveld.
Habitat preference: Forest, woodland and savanna.



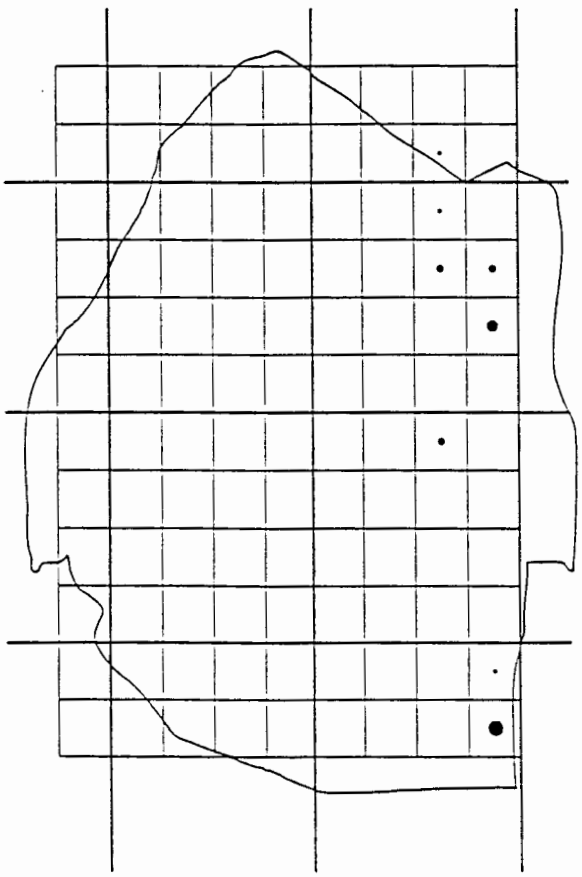
793. Collared sunbird. (Anthreptes collaris)

Recording frequency: 272 (/2263) 12%.
Population estimate: 1 200.
Status: Uncommon breeding resident in the middleveld, lowveld and Lubombos, more common in the north than in the south.
Habitat preference: Forest and woodland.



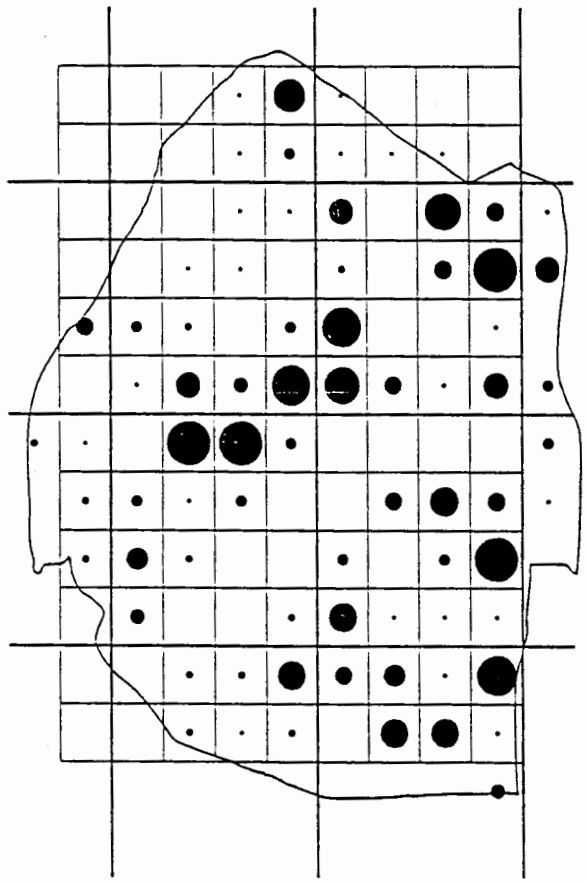
796. Cape white-eye. (Zosterops pallidus)

Recording frequency: 1 309 (/2263) 58%.
Population estimate: 80 000.
Status: A breeding resident, uncommon in the lowveld and very common elsewhere.
Habitat preference: Forest, woodland (including wattle stands) and savanna. Does not occur in the continuous Dichrostachys thicket at Hlane (E9).



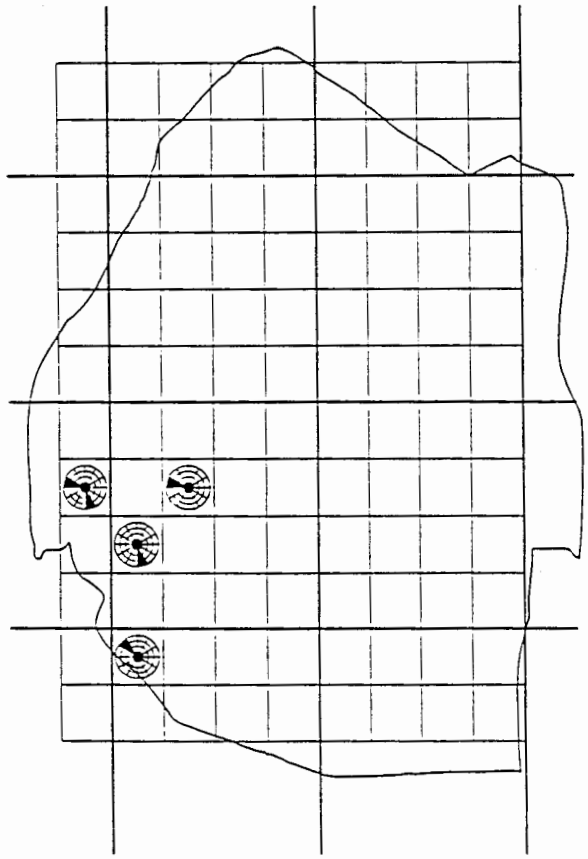
798. Redbilled buffalo weaver. (Bubalornis niger)

Recording frequency: 16 (/2263) 1%.
Population estimate: 80.
Status: Rare breeding resident in the lowveld.
Habitat preference: Knobthorn-marula savanna.



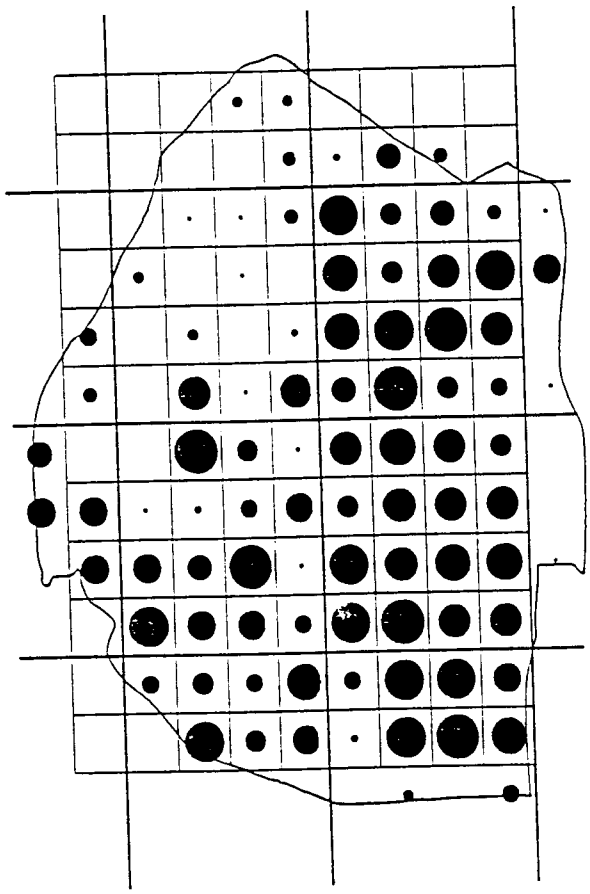
801. House sparrow. (Passer domesticus)

Recording frequency: 524 (/2263) 23%.
Population estimate: 7 000.
Status: An introduced species. Common breeding resident.
Habitat preference: Associated with human habitation in both rural and urban situations.



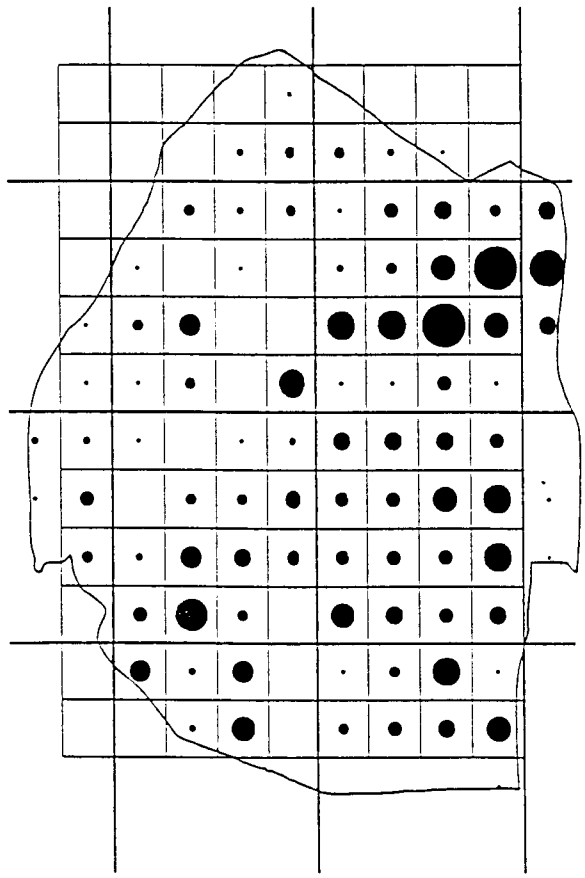
803. Cape sparrow. (Passer melanurus)

Recording frequency: 5 (/2263) 0,3%.
Status: Rare visitor in the southern highveld.
Habitat preference: Grassland and cultivated lands, usually near human habitation.



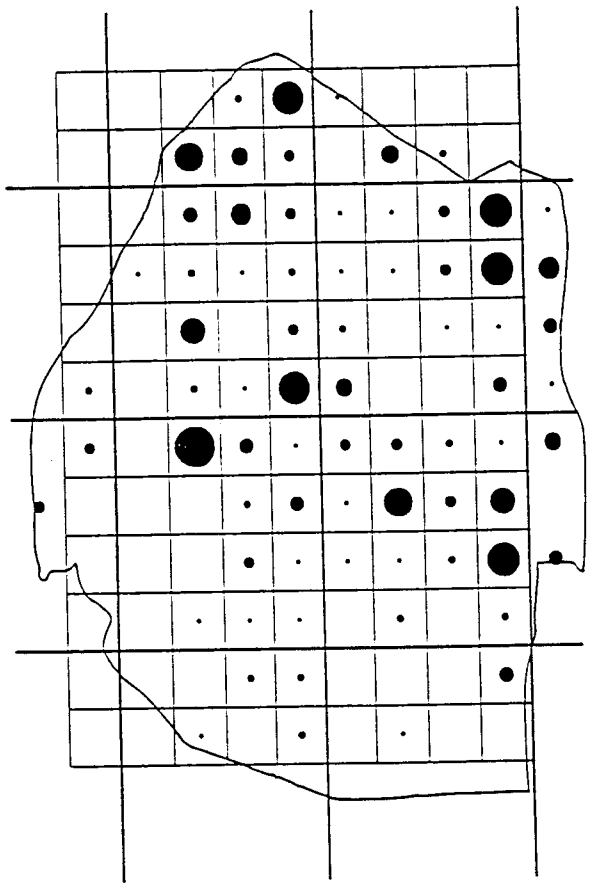
804. Greyheaded sparrow. (Passer griseus)

Recording frequency: 742 (/2263) 33%.
Population estimate: 9 000.
Status: Common breeding resident in the lowveld, southern middleveld and southern highveld. Uncommon visitor elsewhere.
Habitat preference: Woodland, savanna and cultivated lands.



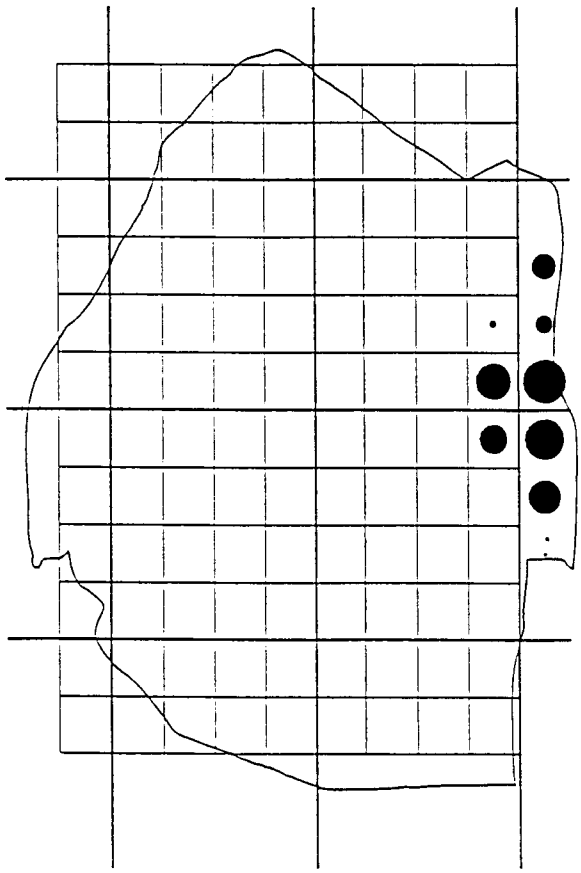
805. Yellowthroated sparrow. (Petronia superciliaris)

Recording frequency: 409 (/2263) 18%.
Population estimate: 4 000.
Status: Uncommon breeding resident.
Habitat preference: Woodland and savanna.



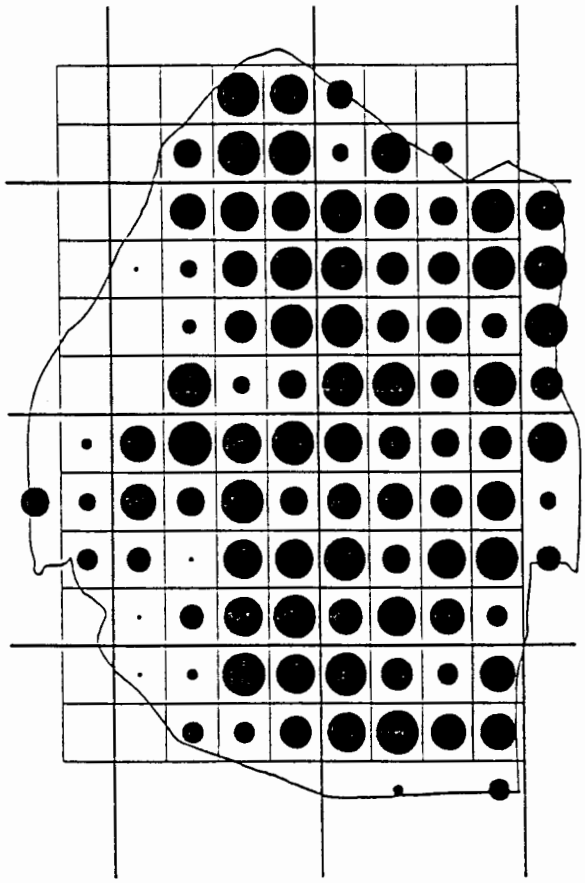
807. Thickbilled weaver. (Amblyospiza albifrons)

Recording frequency: 282 (/2263) 12%.
Population estimate: 3 000.
Status: Uncommon breeding resident.
Habitat preference: Breeds in reedbeds and forages in woodland.



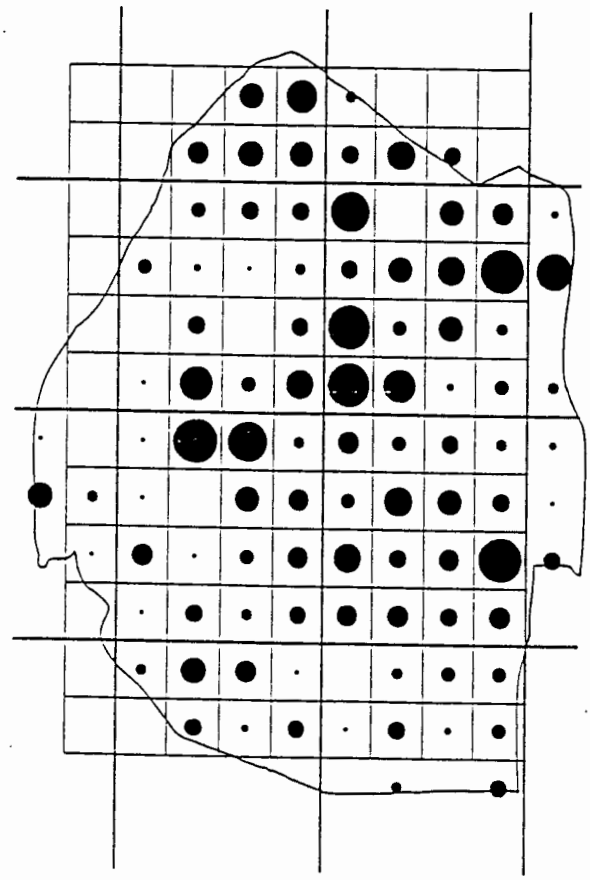
808. Forest weaver. (Ploceus bicolor)

Recording frequency: 73 (/2263) 3%.
Population estimate: 400.
Status: Uncommon breeding resident in the Lubombos.
Habitat preference: Forest and woodland.



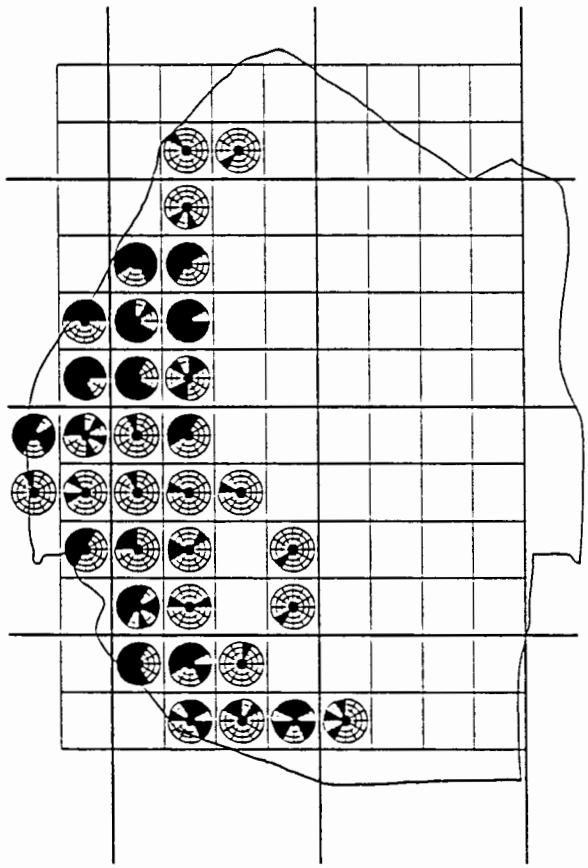
810. Spectacled weaver. (Ploceus ocularis)

Recording frequency: 1 121 (/2263) 50%.
Population estimate: 20 000.
Status: Common breeding resident. Nests are usually solitary.
Habitat preference: Forest, woodland and savanna.



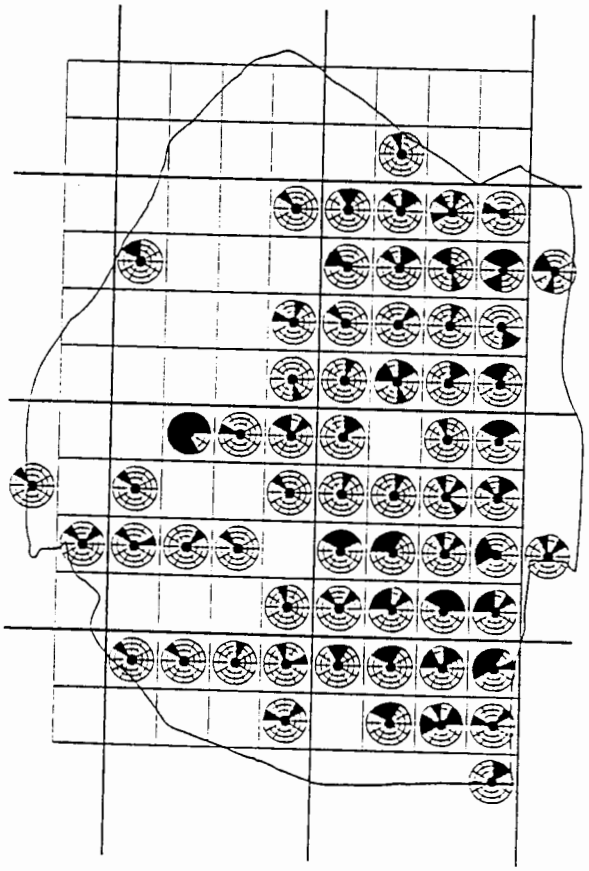
811. Spottedbacked weaver. (Ploceus cucullatus)

Recording frequency: 697 (/2263) 31%.
Population estimate: 20 000.
Status: A breeding resident, very common in the middleveld and lowveld and uncommon elsewhere. Usually breeds in large colonies consisting of up to 100 pairs.
Habitat preference: Woodland and savanna.



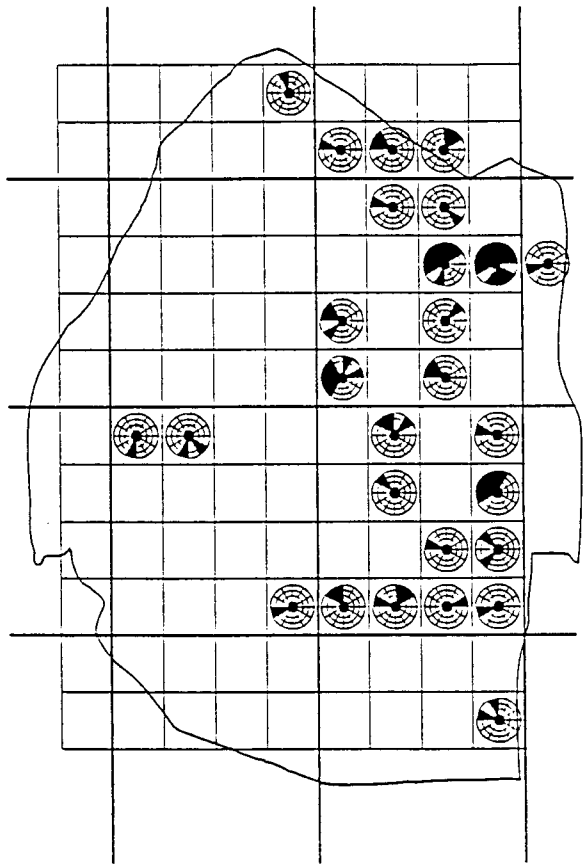
813. Cape weaver. (Ploceus capensis)

Recording frequency: 200 (/2263) 9%.
Population estimate: 3 000.
Status: Uncommon breeding resident in the highveld. Breeds in small colonies consisting of 5-10 pairs.
Habitat preference: Woodland, rocky outcrops in grassland, river banks and reedbeds.



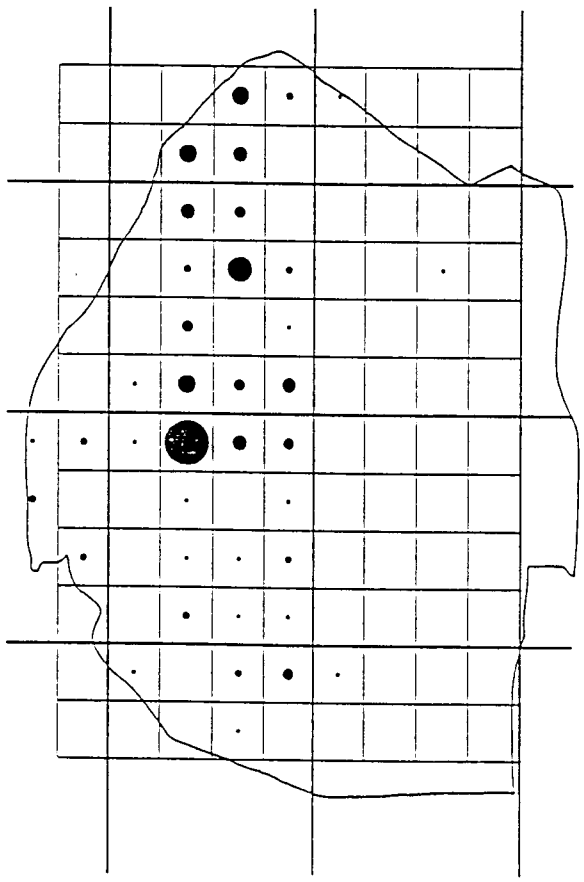
814. Masked weaver. (Ploceus velatus)

Recording frequency: 209 (/2263) 9%.
Population estimate: 3 000.
Status: Uncommon breeding resident. Breeds in small colonies consisting of one male and 2- 10 females. There are few winter records due to the difficulty of identifying the species when in non breeding plumage.
Habitat preference: Woodland and savanna.



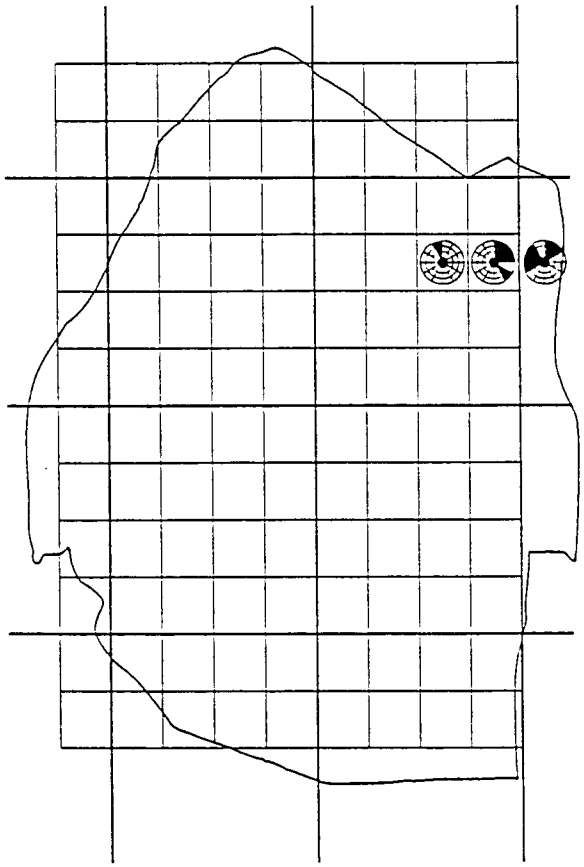
815. Lesser masked weaver. (Ploceus intermedius)

Recording frequency: 75 (/2263) 3%.
Population estimate: 600.
Status: Uncommon breeding resident in the lowveld. Breeds both in small monospecific colonies consisting of up to 20 pairs and in association with Spottedbacked Weavers. Often one or two pairs of this species are to be found nesting in the midst of a large nesting colony of Spottedbacked Weavers. The scarcity of winter records is due to the difficulty of identifying the species when in non-breeding plumage.
Habitat preference: Woodland and savanna. Nests are often suspended over open water.



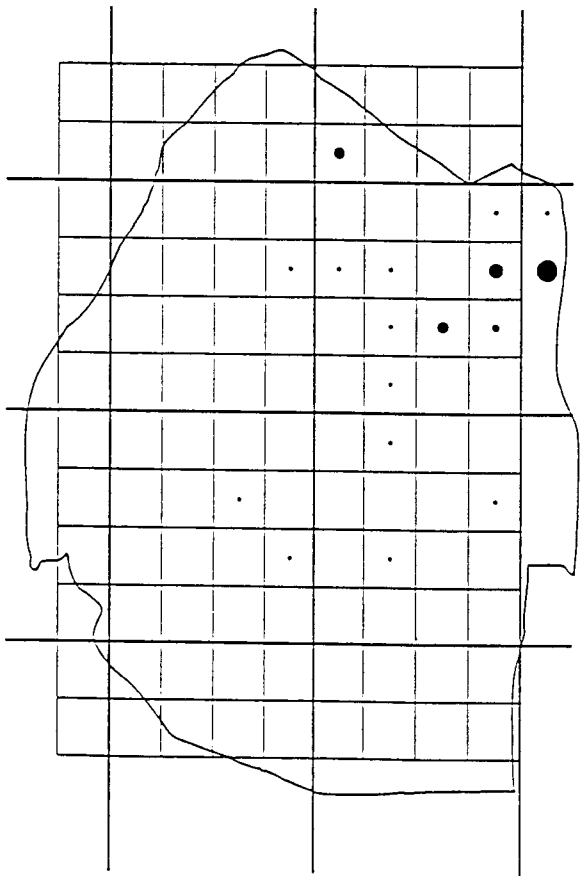
816. Golden weaver. (Ploceus xanthops)

Recording frequency: 119 (/2263) 5%.
Population estimate: 4 000.
Status: Uncommon breeding resident in the middleveld and vagrant elsewhere. Nests are usually solitary.
Habitat preference: Broadleaved savanna, riverbanks and vleis.



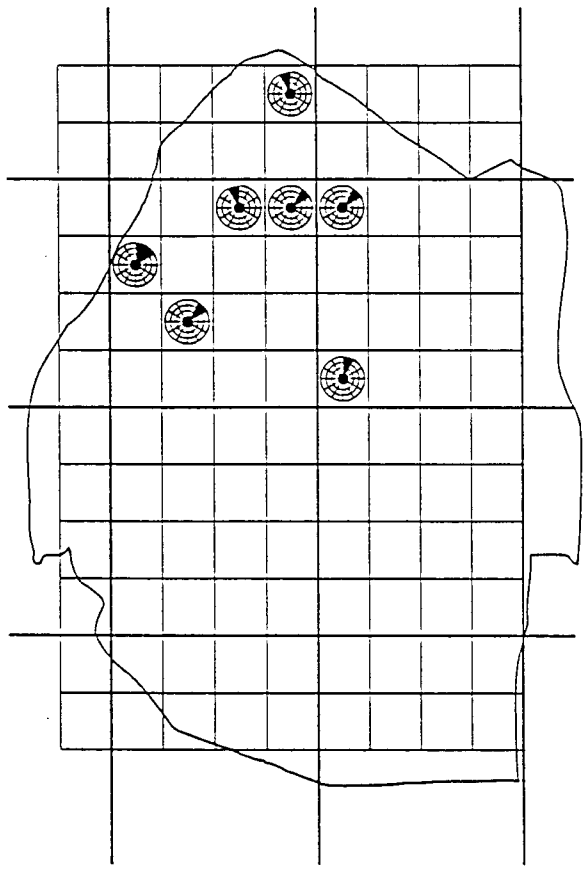
817. Yellow weaver. (Ploceus subaureus)

Recording frequency: 11 (/2263).
Population estimate: 20.
Status: Rare, possibly a breeding summer visitor in the northern lowveld, present in some summers and not others. However the species may be present during winter as it is very difficult to identify in non breeding plumage.
Habitat preference: Breeds in reeds on the banks of the Umbuluzi River (D11) and also in reed lined dams among citrus orchards (D10).



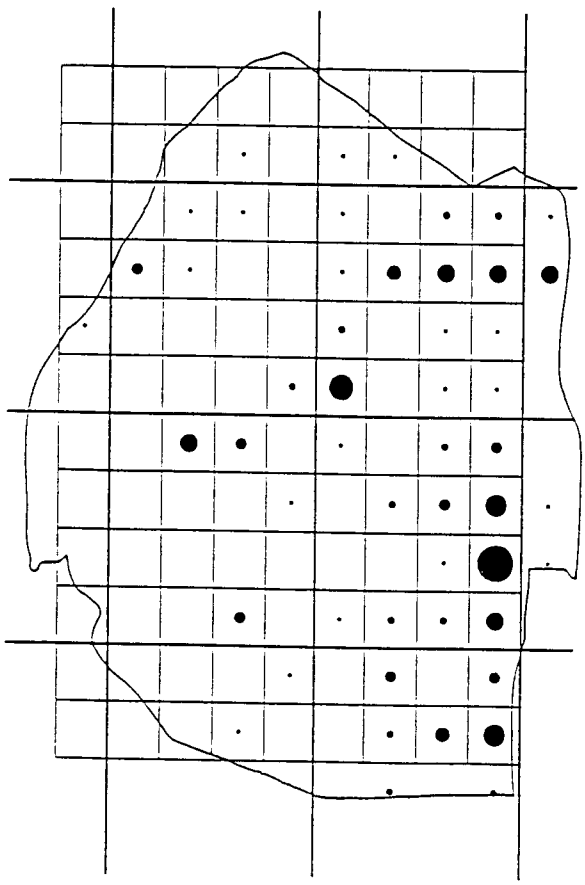
819. Redheaded weaver. (Anaplectes rubriceps)

Recording frequency: 34 (/2263) 2%.
Population estimate: 300.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Acacia woodland and savanna.



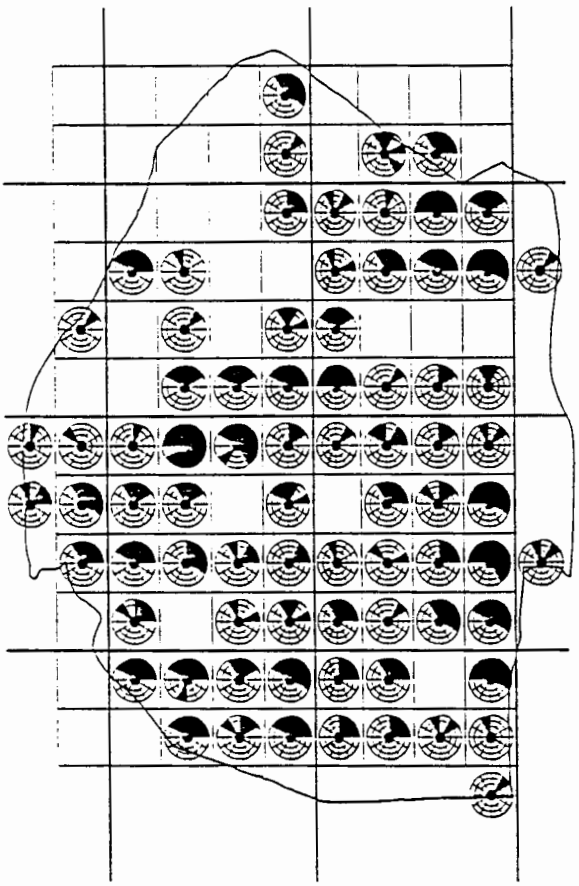
820. Cuckoo finch. (Anomalospiza imberbis)

Recording frequency: 8 (/2263) 0,35%. Population estimate: 10.
Status: Rare, probably a breeding summer migrant in the northern highveld and middleveld.
Habitat preference: Vleis and rank grass.



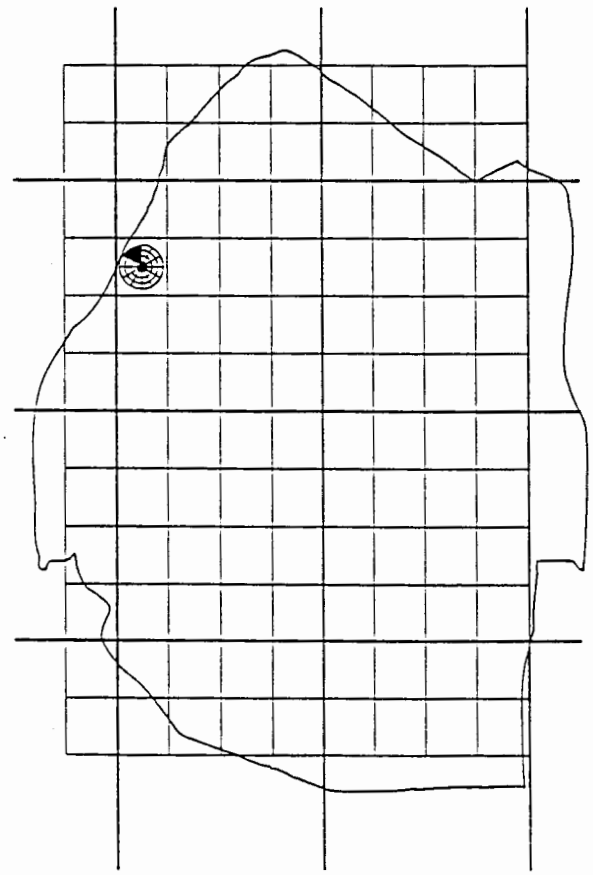
821. Redbilled quelea. (Quelea quelea)

Recording frequency: 142 (/2263) 6%.
Population estimate: 20 000.
Status: Uncommon breeding resident. Numbers probably vary greatly from year to year. Moderate sized flocks of 100 or more were seen in the lowveld. Elsewhere encountered only in smaller flocks of up to 20.
Habitat preference: Savanna and cultivated lands.



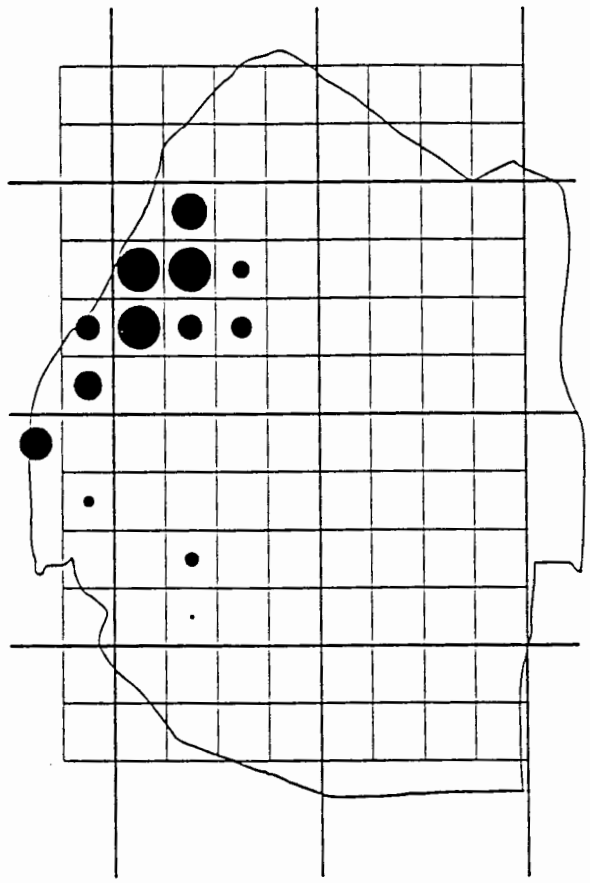
824. Red bishop. (Euplectes orix)

Recording frequency: 397 (/2263) 18%.
Population estimate: 80 000.
Status: Common breeding resident. Seldom recorded in winter due to the difficulty of identifying it when in non breeding plumage.
Habitat preference: Vleis, grassland and cultivated lands. Breeds in reedbeds.



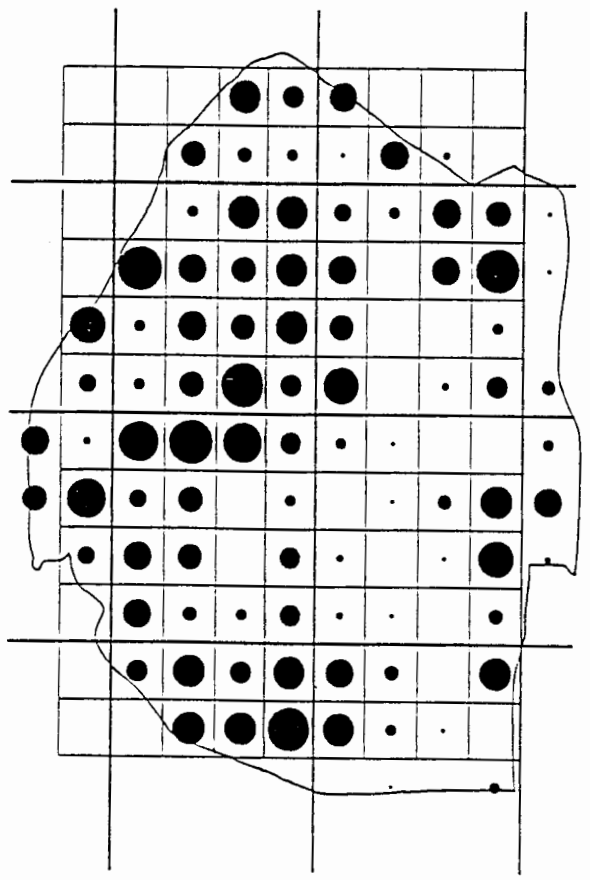
826. Golden bishop. (Euplectes afer)

Recording frequency: 2 (/2263) 0,1%.
Population estimate: 20.
Status: Rare breeding visitor in the northern highveld. Was observed for the first time in Swaziland at Hawane during November and December of 1991 (D3) (R. Boycott, R. & M. Kirker, C. & L. van der Walt).
Habitat preference: Vleis and rank grass.



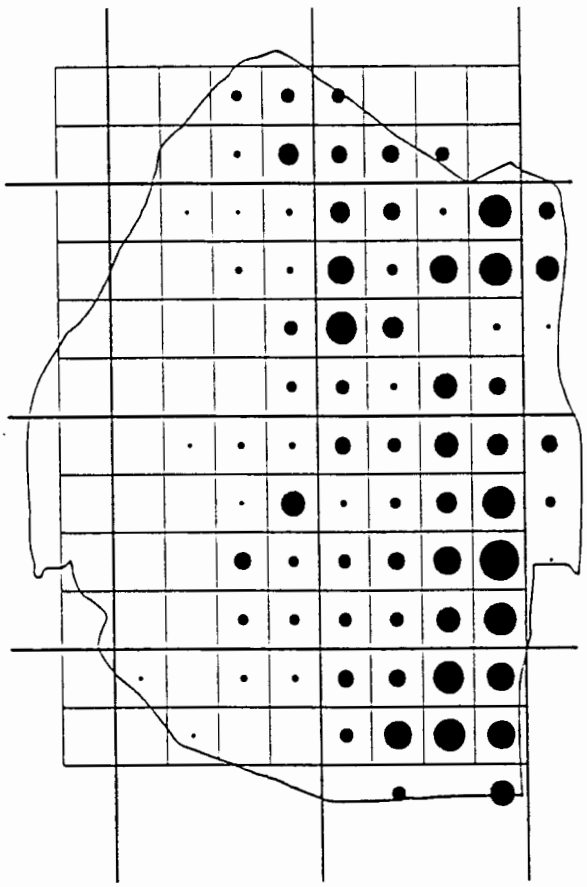
827. Yellowrumped widow. (Euplectes capensis)

Recording frequency: 141 (/2263) 6%.
Population estimate: 20 000.
Status: Uncommon breeding resident in the northern highveld.
Habitat preference: Highveld grassland.



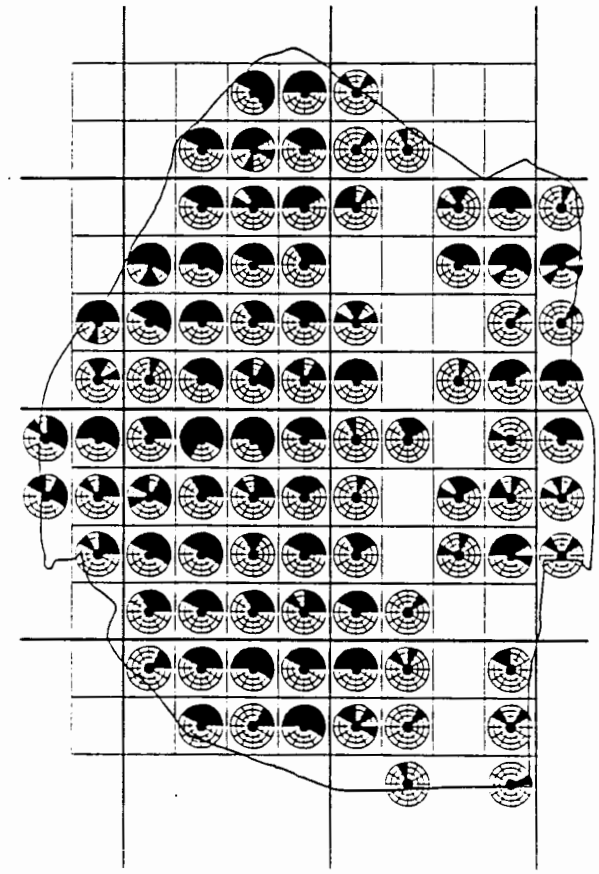
828. Redshouldered widow. (Euplectes axillaris)

Recording frequency: 771 (/2263) 34%.
Population estimate: 40 000.
Status: Common breeding resident in most regions but largely absent from the western lowveld.
Habitat preference: Grassland, vleis and cultivated lands (especially sugar cane fields).



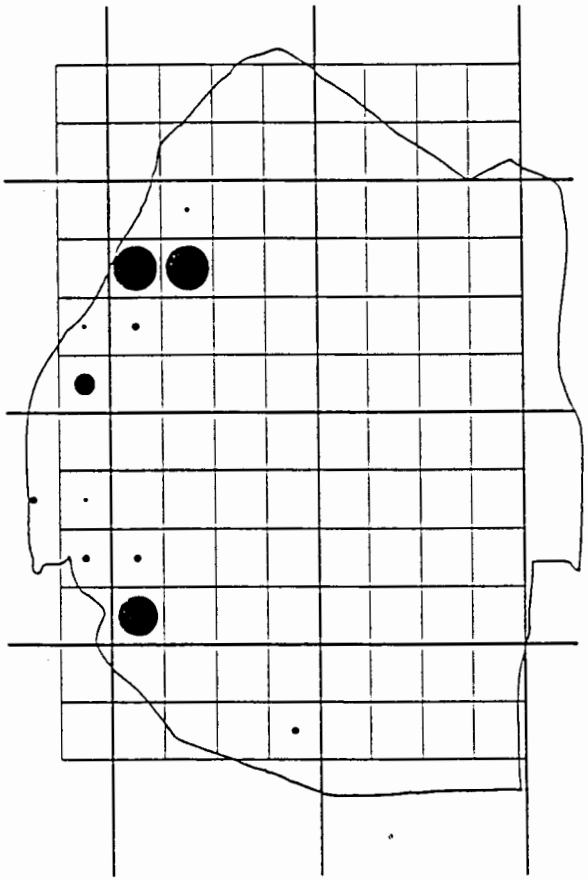
829. Whitewinged widow. (Euplectes albonotatus)

Recording frequency: 409 (/2263) 18%.
Population estimate: 10 000.
Status: Common breeding resident in the lowveld and Lubombos and uncommon visitor in the middleveld.
Habitat preference: Vleis, savanna and cultivated lands.



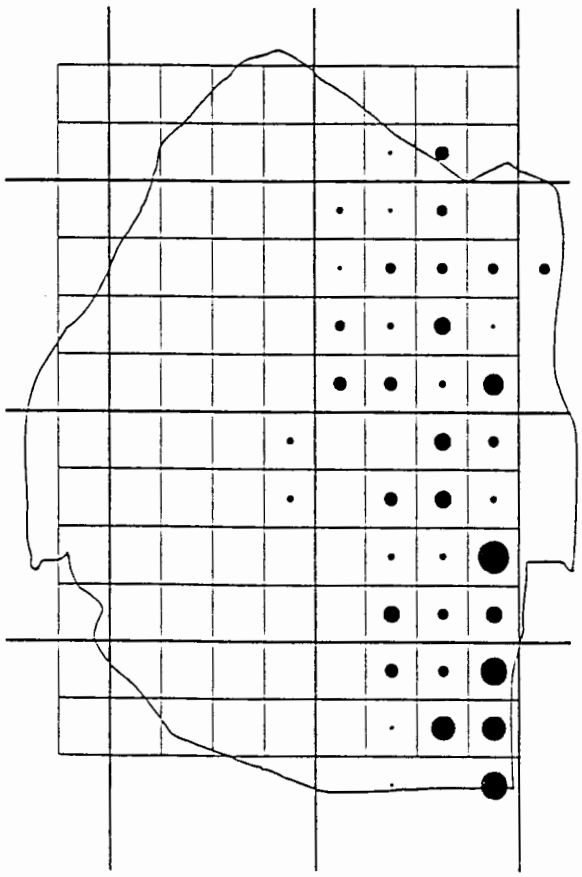
831. Redcollared widow. (Euplectes ardens)

Recording frequency: 529 (/2263) 23%.
Population estimate: 80 000.
Status: Common breeding resident in most areas, but mostly absent from the western lowveld. Seldom recorded in winter due to the difficulty of identifying it in non breeding plumage.
Habitat preference: Vleis, grassland, savanna and cultivated lands.



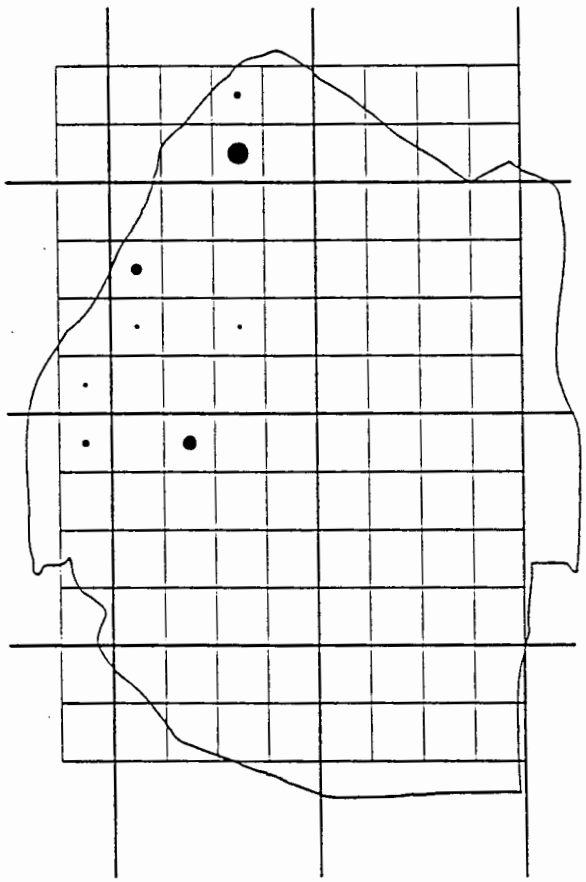
832. Longtailed widow. (Euplectes progne)

Recording frequency: 100 (/2263) 4%.
Population estimate: 1 200.
Status: Uncommon breeding resident in the highveld.
Habitat preference: Highveld grassland and vleis.



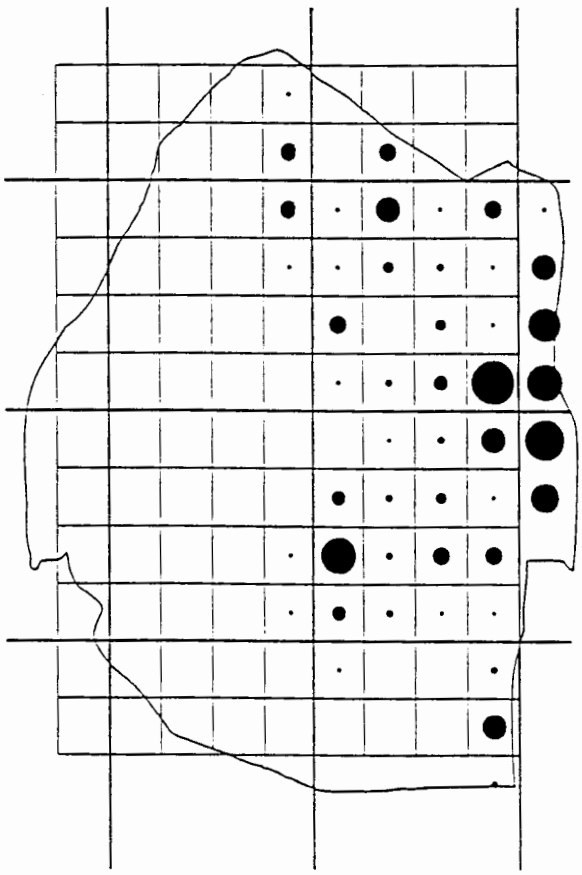
834. Melba finch. (Pytilia melba)

Recording frequency: 150 (/2263) 7%.
Population estimate: 10 000.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Acacia woodland and savanna.



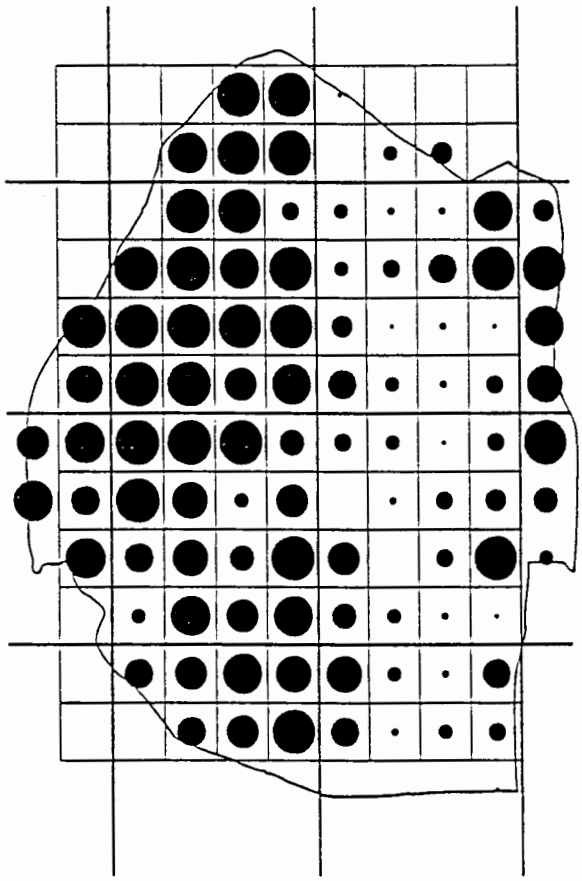
835. Green twinspot. (Mandingoa nitidula)

Recording frequency: 27 (/2263) 1%.
Population estimate: 300.
Status: Uncommon breeding resident in the highveld and middleveld.
Habitat preference: Forest.



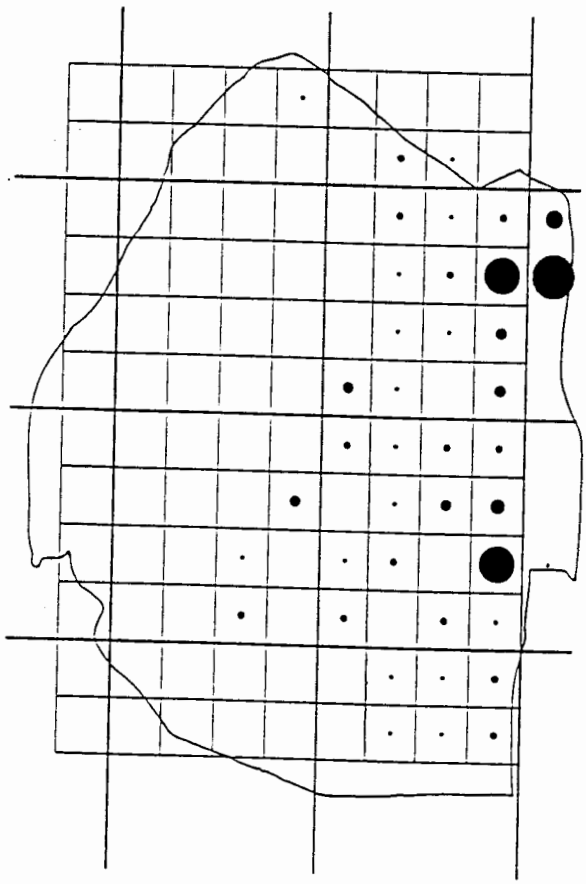
838. Pinkthroated twinspot. (Hypargos margaritatus)

Recording frequency: 191 (/2263) 8%.
Population estimate: 20 000.
Status: Uncommon breeding resident in the lowveld and Lubombos. During the winter of 1992, after data collection for the atlas had been completed, the species was frequently observed at Phophonyane (B5) in the middleveld to the west of its normal range in a habitat also occupied by the green twinspot.
Habitat preference: Woodland thickets.



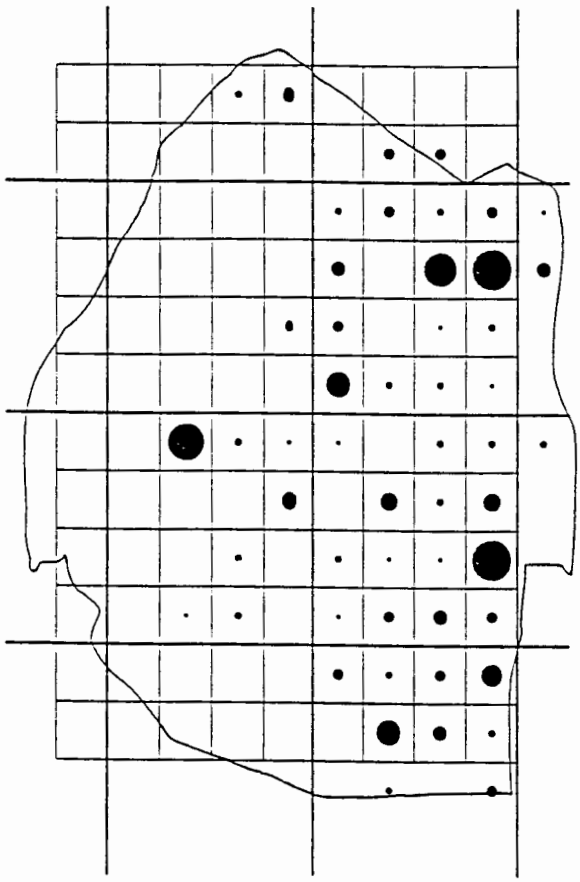
840. Bluebilled firefinch. (Lagonosticta rubricata)

Recording frequency: 1 100 (/2263) 49%.
Population estimate: 200 000.
Status: A breeding resident, very common in the highveld, middleveld and Lubombos and uncommon in the lowveld.
Habitat preference: Found in the undergrowth in all wooded habitats and cultivated lands.



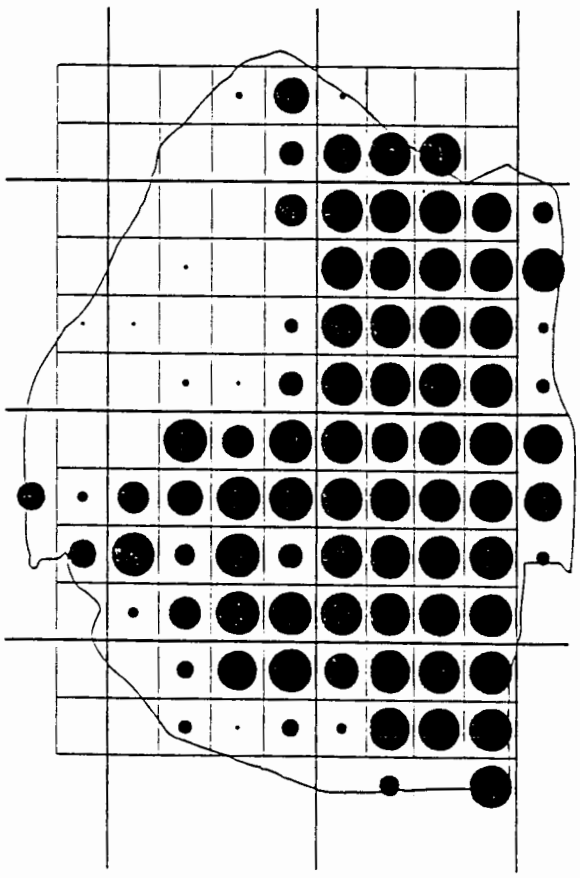
841. Jameson's firefinch. (Lagonosticta rhodopareia)

Recording frequency: 117 (/2263) 5%.
Population estimate: 2 000.
Status: Uncommon breeding resident in the lowveld.
Habitat preference: Thickets in woodland and savanna.



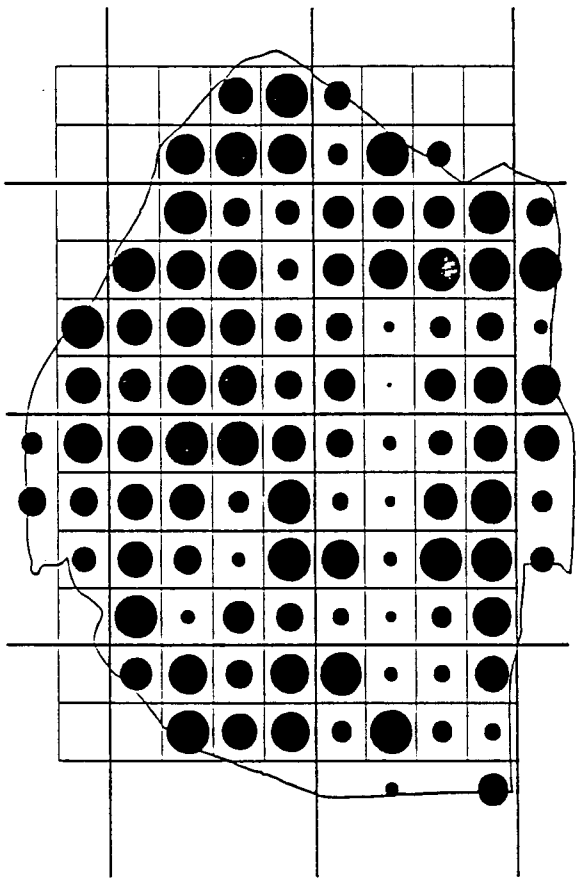
842. Redbilled firefinch. (Lagonosticta senegala)

Recording frequency: 201 (/2263) 9%.
Population estimate: 4 000.
Status: Uncommon breeding resident in the lowveld middleveld and Lubombos.
Habitat preference: Savanna, vleis and cultivated lands.



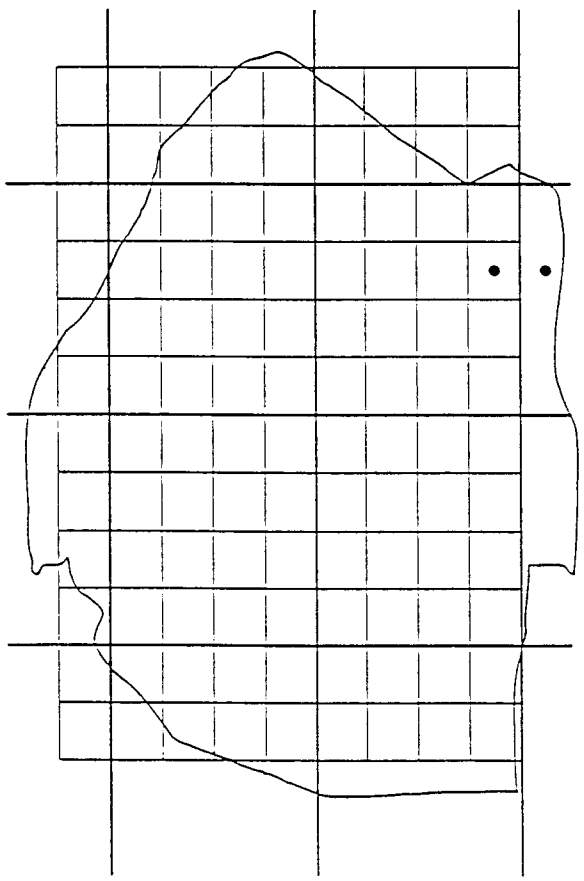
844. Blue waxbill. (Uraeginthus angolensis)

Recording frequency: 1 183 (/2263) 52%.
Population estimate: 800 000.
Status: Very common breeding resident in the lowveld, Lubombos and southern middleveld and an uncommon visitor elsewhere.
Habitat preference: Woodland and savanna.



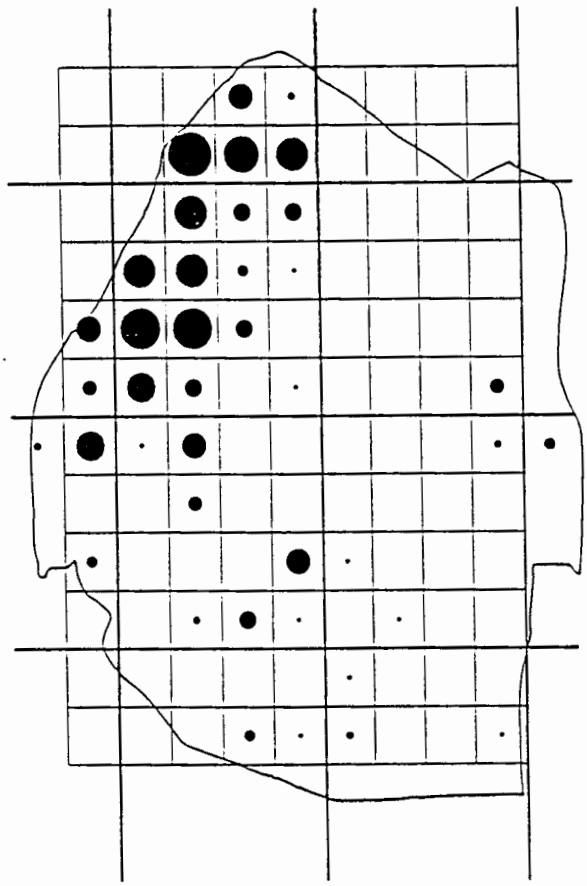
846. Common waxbill. (Estrilda astrild)

Recording frequency: 1 309 (/2263) 58%.
Population estimate: 500 000.
Status: Very common breeding resident in most areas but uncommon in the western lowveld.
Habitat preference: Thickets, vleis, riverbanks and cultivated lands.



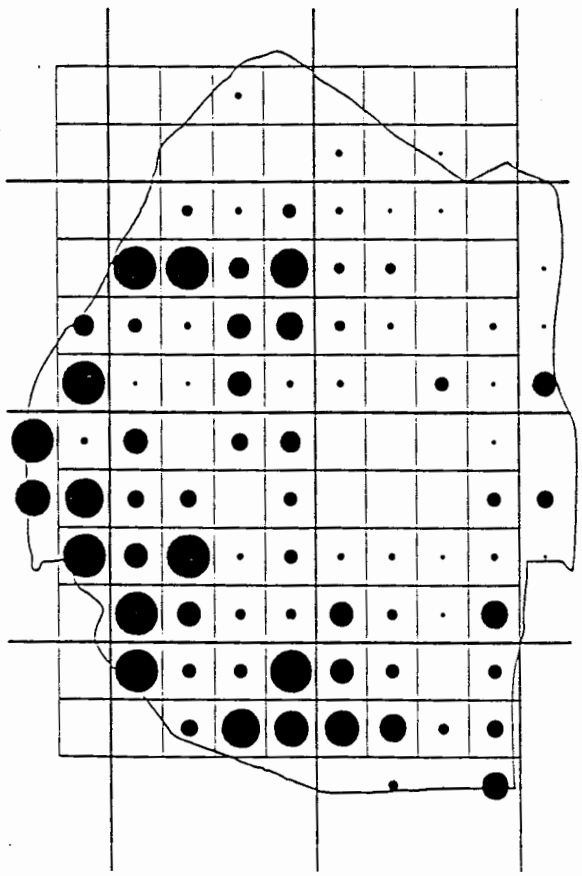
848. Grey waxbill. (Estrilda perreini)

Recording frequency: 6 (/2263) 0,3%.
Status: Uncommon visitor in the Umbuluzi gorge.
Habitat preference: Riverine thickets.



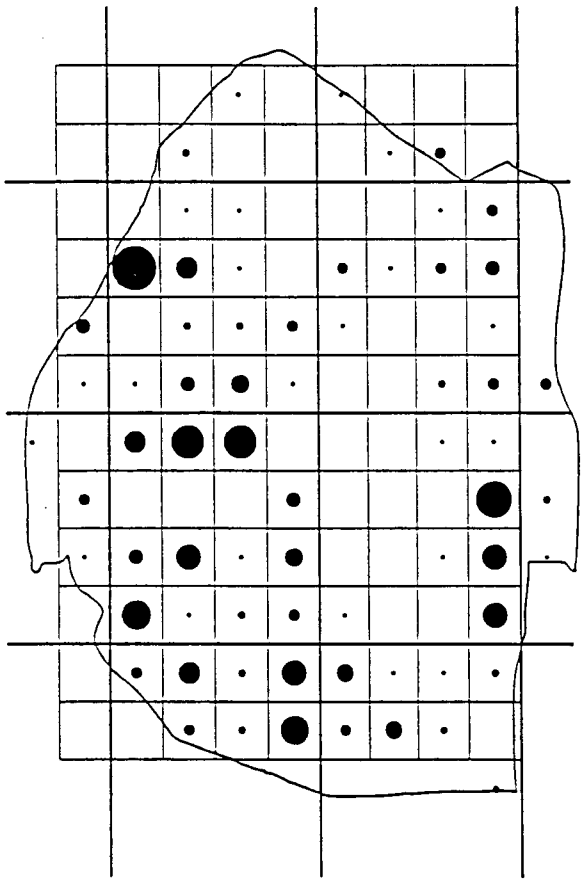
850. Swee waxbill. (Estrilda melanotis)

Recording frequency: 287 (/2263) 13%.
Population estimate: 4 000.
Status: A breeding resident, common in the northern highveld and uncommon in the middleveld and the highest part of the Lubombos.
Habitat preference: Forest and dense broad leaved woodland.



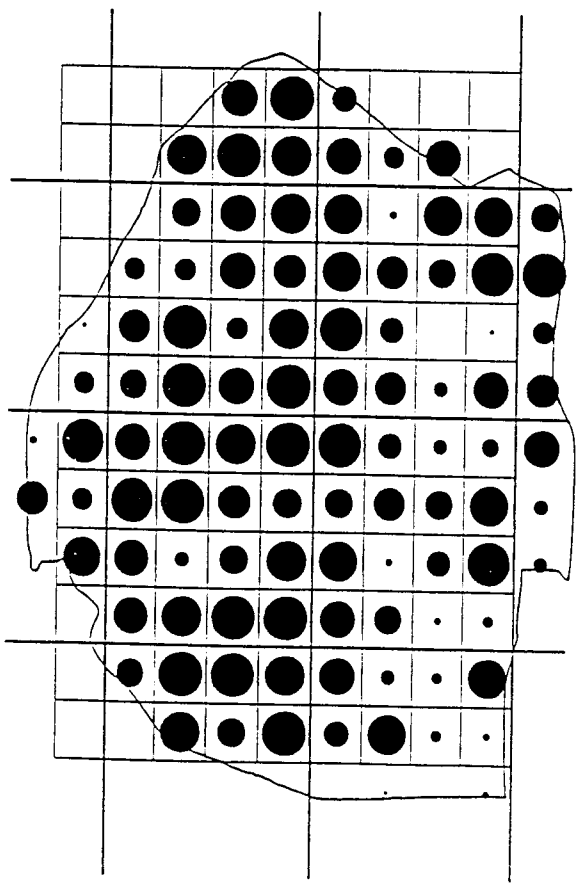
852. Quail finch. (Ortygospiza atricollis)

Recording frequency: 450 (/2263) 20%.
Population estimate: 80 000.
Status: A breeding resident, common in the highveld and uncommon elsewhere.
Habitat preference: Vleis, grassland and cultivated land.



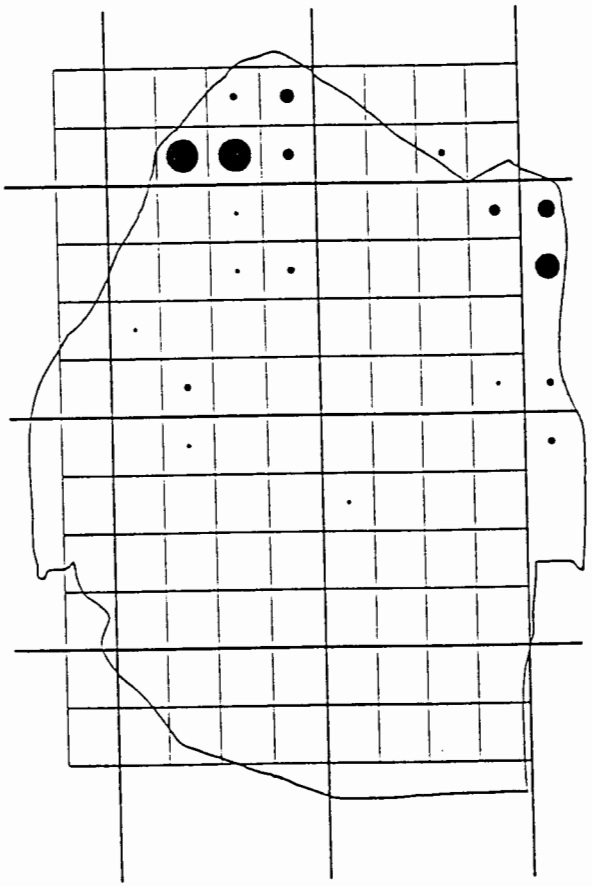
854. Orangebreasted waxbill. (Sporaeginthus subflavus)

Recording frequency: 285 (/2263) 13%.
Population estimate: 7 000.
Status: Uncommon breeding resident.
Habitat preference: Vleis, riverbanks and cultivated lands.



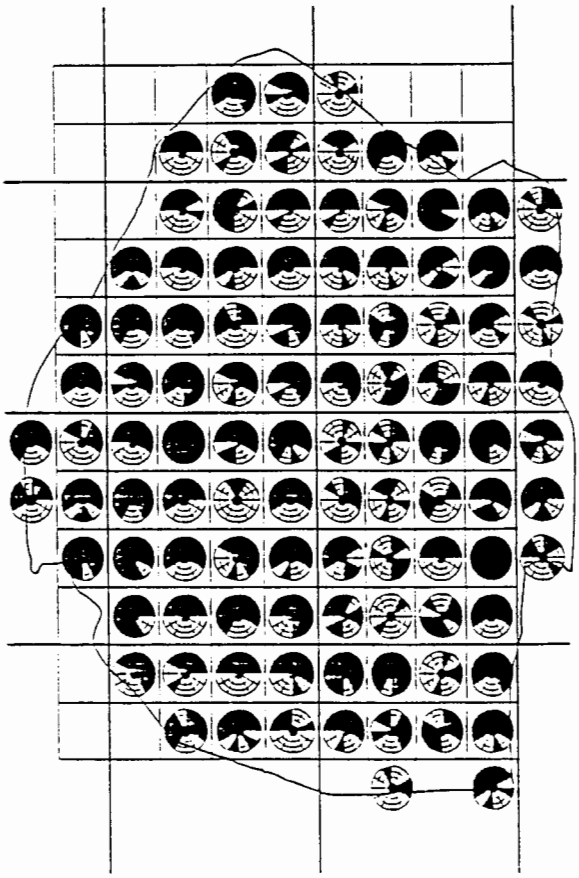
857. Bronze mannikin. (Spermestes cucullatus)

Recording frequency: 1 284 (/2263) 57%.
Population estimate: 300 000.
Status: Very common breeding resident.
Habitat preference: Woodland (including wattle stands) and savanna.



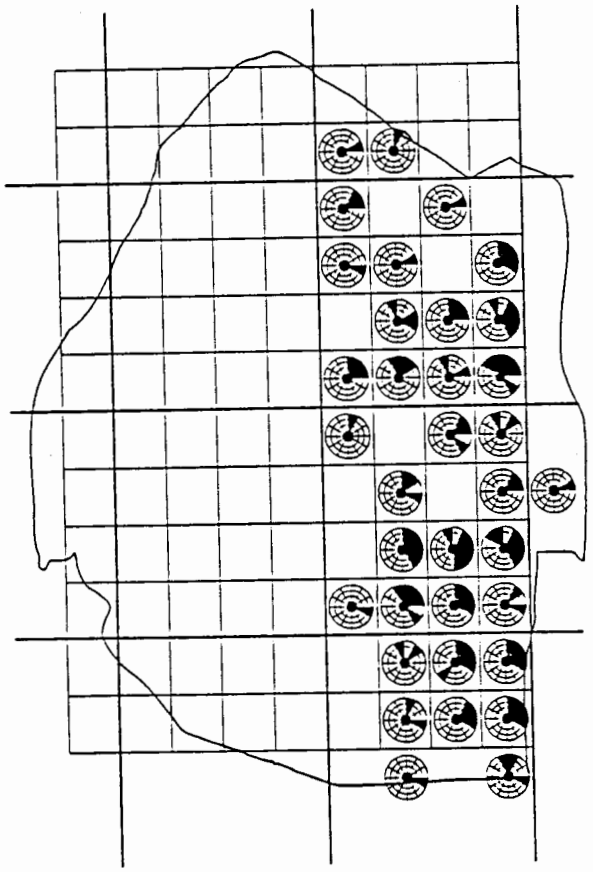
858. Redbacked mannikin. (Spermestes bicolor)

Recording frequency: 72 (/2263) 3%.
Population estimate: 400.
Status: Uncommon breeding resident.
Habitat preference: Riverine woodland.



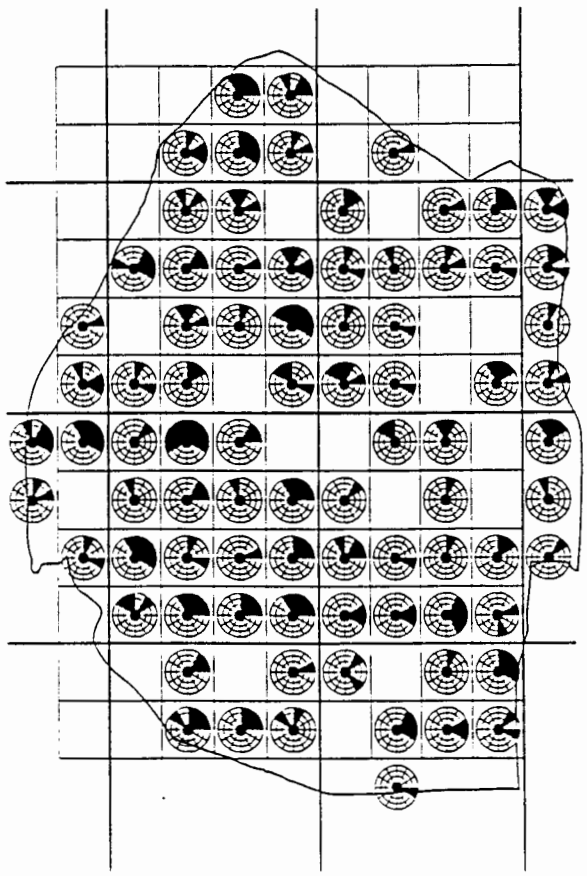
860. Pintailed whydah. (Vidua macroura)

Recording frequency: 1 091 (/2263) 48%.
Population estimate: 50 000.
Status: Very common breeding resident. Recorded less often during winter as it is inconspicuous in non breeding plumage.
Habitat preference: Clearings in woodland, savanna, grassland, vleis and cultivated lands.



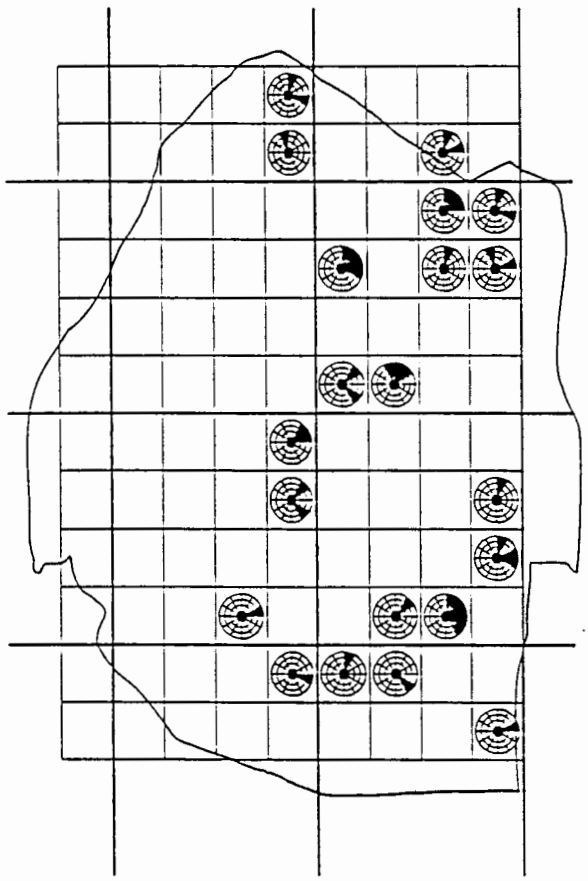
862. Paradise whydah. (Vidua paradisea)

Recording frequency: 109 (/2263) 5%.
Population estimate: 3 000.
Status: Uncommon breeding resident in the lowveld. Not recorded outside the breeding season due to the difficulty of identifying it in non breeding plumage.
Habitat preference: Thorn savanna. Usually encountered at the roadside.



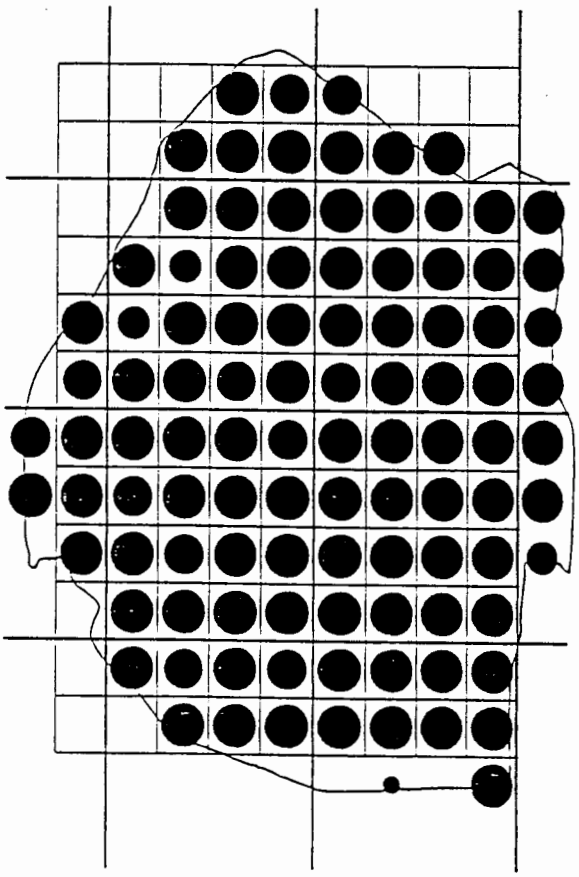
864. Black widowfinch. (Vidua funerea)

Recording frequency: 234 (/2263) 10%.
Population estimate: 15 000.
Status: Common breeding resident. Not recorded outside of its breeding season due to the difficulty of identification when in non breeding plumage.
Habitat preference: Woodland (including wattle stands) and savanna.



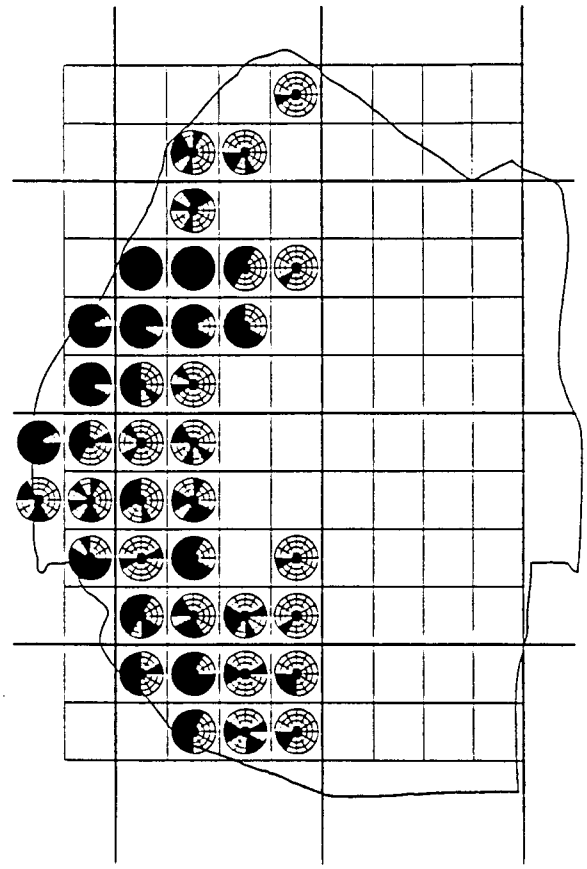
867. Steelblue widowfinch. (Vidua chalybeata)

Recording frequency: 43 (/2263) 2%.
Population estimate: 400.
Status: Uncommon breeding resident in the lowveld. Not recorded outside of its breeding season due to the difficulty of identification when in non breeding plumage.
Habitat preference: Acacia woodland and savanna.



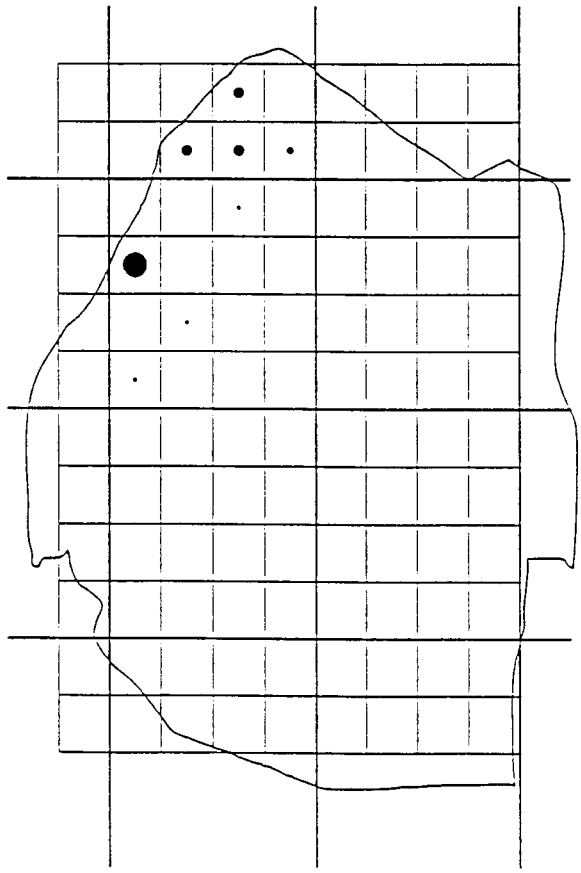
869. Yelloweyed canary. (Serinus mozambicus)

Recording frequency: 1 856 (/2263) 82%.
Population estimate: 600 000.
Status: Very common breeding resident.
Habitat preference: Woodland (including wattle stands), scrub woodland, savanna and cultivated lands.



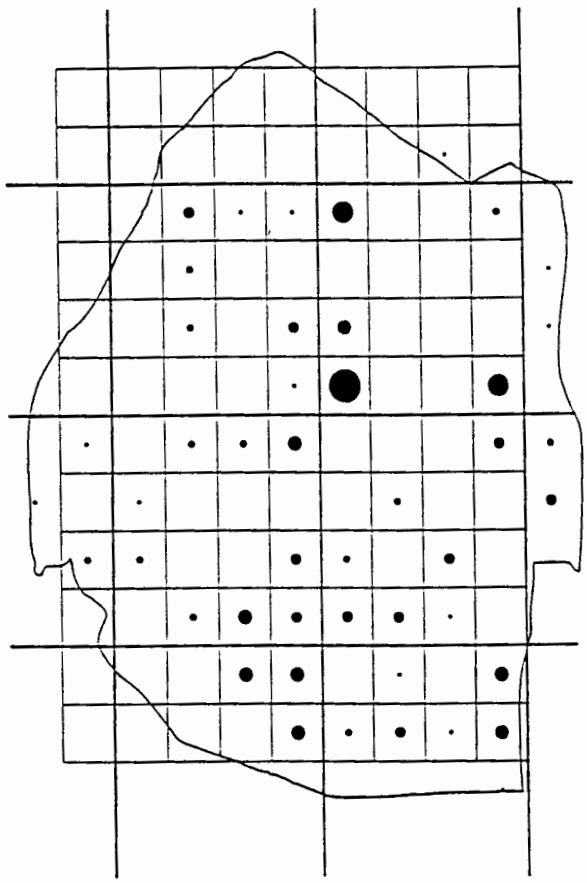
872. Cape canary. (Serinus canicollis)

Recording frequency: 324 (/2263) 14%.
Population estimate: 20 000.
Status: Common breeding resident in the highveld. The distribution records per month suggest that there may be a partial movement out of Swaziland between February and May.
Habitat preference: Scrub woodland, rocky outcrops and wattle stands.



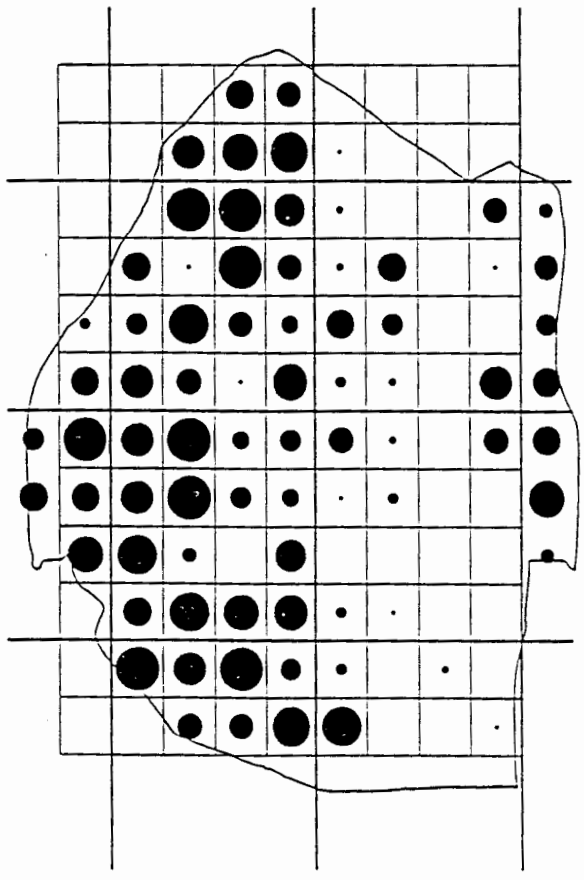
873. Forest canary. (Serinus scotops)

Recording frequency: 21 (/2263) 1%.
Population estimate: 200.
Status: Uncommon breeding resident in the northern highveld.
Habitat preference: Forest.



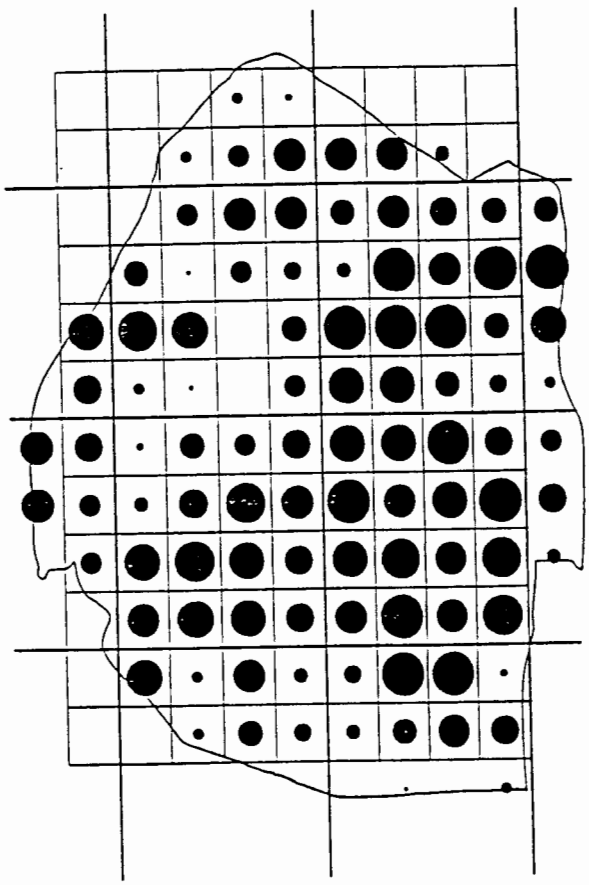
877. Bully canary. (Serinus sulphuratus)

Recording frequency: 123 (/2263) 5%.
Population estimate: 5 000.
Status: Uncommon breeding resident.
Habitat preference: Woodland and savanna.



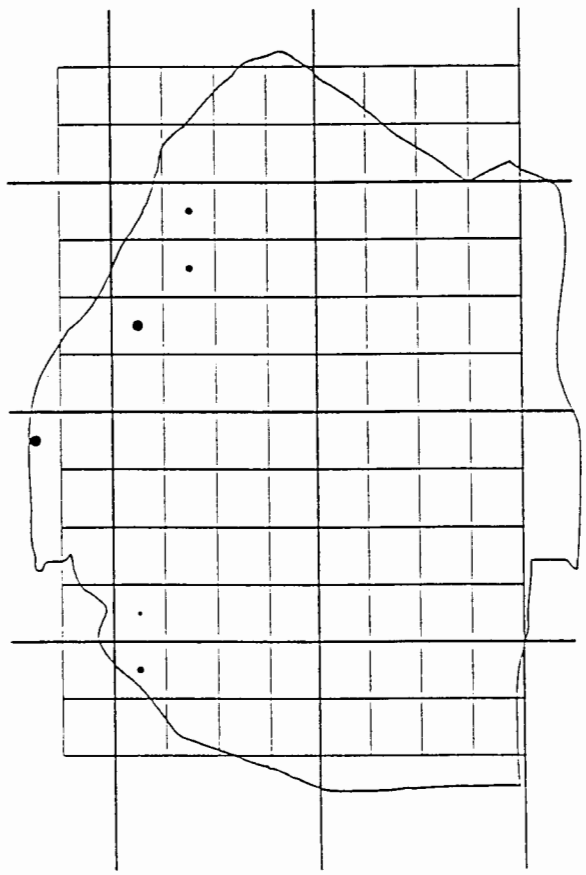
881. Streakyheaded canary. (Serinus gularis)

Recording frequency: 636 (/2263) 28%.
Population estimate: 20 000.
Status: Common breeding resident in most regions but largely absent from the eastern lowveld.
Habitat preference: Broad leaved woodland and wattle stands.



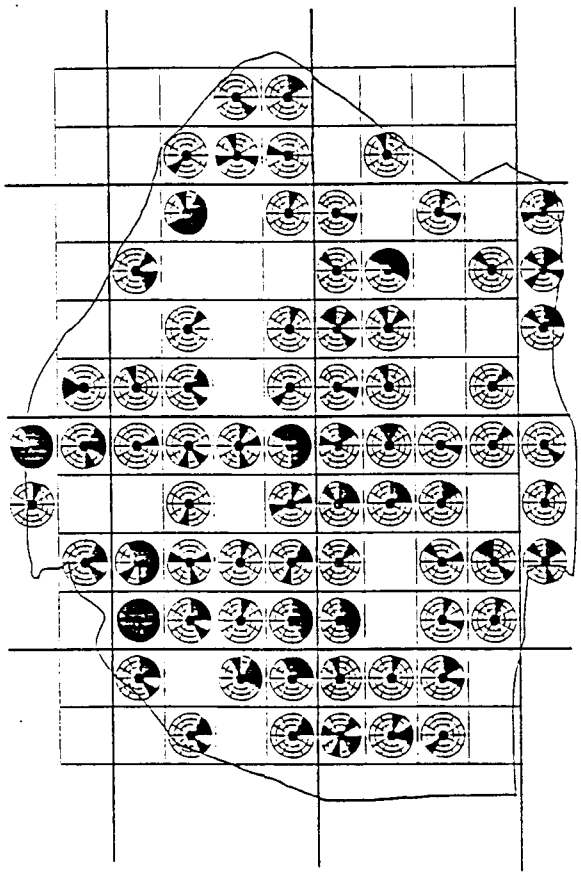
884. Goldenbreasted bunting. (Emberiza flaviventris)

Recording frequency: 926 (/2263) 41%.
Population estimate: 40 000.
Status: Common breeding resident.
Habitat preference: Woodland (including wattle stands) and savanna.



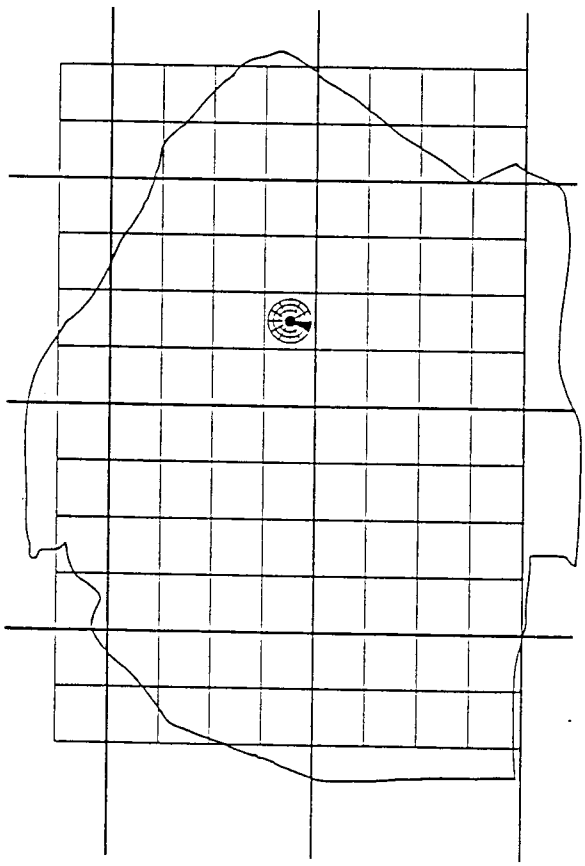
885. Cape bunting. (Emberiza capensis)

Recording frequency: 14 (/2263) 1%.
Population estimate: 100.
Status: Rare breeding resident in the highveld.
Habitat preference: Rocky outcrops.



886. Rock bunting. (Emberiza tahapisi)

Recording frequency: 209 (/2263) 9%.
Population estimate: 5 000.
Status: Uncommon breeding resident.
Habitat preference: Woodland (usually on hillsides), wattle stands and rocky outcrops.



887. Larklike bunting. (Emberiza impetuani)

Recording frequency: 1 (/2263).
Two birds were observed once near Luve in April 1991 (VP).

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